

User's Guide

Volume 1

General Information

Agilent 4155B Semiconductor Parameter Analyzer

Agilent 4156B Precision Semiconductor Parameter Analyzer



Agilent Technologies

Agilent Part No. 04156-90100

Printed in USA January 2000

Edition 3

Legal Notice

The information contained in this document is subject to change without notice.

Copyright © 1997, 2000 Agilent Technologies

This document contains information which is protected by copyright. All rights are reserved. Reproduction, adaptation, or translation without prior written permission is prohibited, except as allowed under the copyright laws.

- **Product Warranty**

Agilent Technologies warrants Agilent Technologies hardware, accessories and supplies against defects in materials and workmanship for the period of one year from the warranty start date specified below. If Agilent Technologies receives notice of such defects during the warranty period, Agilent Technologies will, at its option, either repair or replace products which prove to be defective. Replacement products may be either new or like-new.

Warranty service of this product will be performed at Agilent Technologies. Buyer shall prepay shipping charges to Agilent Technologies and Agilent Technologies shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to Agilent Technologies from another country.

Agilent Technologies does not warrant that the operation of Agilent Technologies products will be uninterrupted or error free. If Agilent Technologies is unable, within a reasonable time, to repair or replace any product to a condition as warranted, customer will be entitled to a refund of the purchase price upon prompt return of the product.

The Agilent Technologies products may contain remanufactured parts equivalent to new in performance or may have been subject to incidental use.

The warranty period begins on the date of delivery or on the date of installation if installed by Agilent Technologies. If customer schedules or delays Agilent Technologies installation more than 30 days after delivery, warranty begins on the 31st day from delivery.

Warranty does not apply to defects resulting from (a) improper or inadequate maintenance or calibration, (b) software, interfacing, parts or supplies not supplied by Agilent Technologies, (c) unauthorized modification or misuse, (d) operation outside of the published environmental specifications for the product, or (e) improper site preparation or maintenance.

To the extent allowed by local law, the above warranties are exclusive and no other warranty or condition, whether written or oral, is expressed or implied and Agilent Technologies specifically disclaims any implied warranties or conditions of merchantability, satisfactory quality, and fitness for a particular purpose.

Agilent Technologies will be liable for damage to tangible property per incident up to the greater of \$300,000 or the actual amount paid for the product that is the subject of the claim, and for damages for bodily injury or death, to the extent that all such damages are determined by a court of competent jurisdiction to have been directly caused by a defective Agilent Technologies product.

To the extent allowed by local law, the remedies in this warranty statement are customer's sole and exclusive remedies. Except as indicated above, in no event will Agilent Technologies or its suppliers be liable for loss of data or for direct, special, incidental, consequential (including lost profit or data), or other damage, whether based in contract, tort, or otherwise.

For consumer transactions in Australia and New Zealand: the warranty terms contained in this statement, except to the extent lawfully permitted, do not exclude, restrict or modify and are in addition to the mandatory statutory rights applicable to the sale of this product to you.

- **Assistance**

Product maintenance agreements and other customer assistance agreements are available for Agilent Technologies products.

For any assistance, contact your nearest Agilent Technologies Sales Office.

- **Certification**

Agilent Technologies, Inc. certifies that this product met its published specifications at the time of shipment from the factory. Agilent Technologies further certifies that its calibration measurements are traceable to the National Institute of Standards and Technology (NIST), to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

- **Safety Summary**

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual may impair the protections provided by the equipment. In addition, it violates safety standards of design, manufacture, and intended use of the instrument. Agilent Technologies, Inc. assumes no liability for customer's failure to comply with these requirements.

NOTE

Agilent 4155B/4156B/41501B comply with INSTALLATION CATEGORY II for mains input and INSTALLATION CATEGORY I for measurement input terminals, and POLLUTION DEGREE 2 defined in IEC 1010-1.

Agilent 4155B/4156B/41501B are INDOOR USE products.

NOTE

LEDs in Agilent 4155B/4156B/41501B are Class 1 in accordance with IEC 825-1. CLASS 1 LED PRODUCT.

- *GROUND THE INSTRUMENT*

This is Safety Class I instrument. To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The power terminal and the power cable must meet International Electrotechnical Commission (IEC) safety standards.

- *DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE*

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

- *KEEP AWAY FROM LIVE CIRCUITS*

Operation personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

- *DO NOT SERVICE OR ADJUST ALONE*

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

- *DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT*

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Agilent Technologies Sales and Service Office for services and repair to ensure that safety features are maintained.

- *DANGEROUS PROCEDURE WARNINGS*

Warnings, such as example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING

Dangerous Voltage, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

- **Safety Symbols**

The general definitions of safety symbols used on equipment or in manuals are listed below.



Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.



Indicates dangerous voltage and potential for electrical shock. Do not touch terminals that have this symbol when instrument is on.



Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating equipment.



Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.



Indicates earth (ground) terminal.



Alternating current.



Direct current.



ON (Supply).



OFF (Supply).



STANDBY (Supply).

CAT I

Means INSTALLATION CATEGORY I. Measurement terminals on the rear panel comply with INSTALLATION CATEGORY I.

WARNING

The warning sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personal.

CAUTION

The caution sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

- **Herstellerbescheinigung**

GEÄUSCHEMISSION

$L_{pa} < 70 \text{ dB}$

am Arbeitsplatz

normaler Betrieb

nach DIN 45635 T. 19

- **Manufacturer's Declaration**

ACOUSTIC NOISE EMISSION

$L_{pa} < 70 \text{ dB}$

operator position

normal operation

per ISO 7779

Printing History

Edition 1:	August 1997
Edition 2:	September 1997
Edition 3:	January 2000

Microsoft, Windows, MS-DOS and Excel are registered trademarks of Microsoft Corporation.

Lotus and 1-2-3 are registered trademarks of Lotus Development Corporation.

NFS is a trademark of Sun Microsystems, Inc.

UNIX is a registered trademark in the United States and other countries, licensed exclusively through X/Open Company Limited.

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014

Manufacturer's Name Agilent Technologies Japan, Ltd

Manufacturer's Address: 9-1, Takakura-cho, Hachioji-shi
Tokyo, 192-8510 Japan

Declares that the product

Product Name: Semiconductor Parameter Analyzer
Precision Semiconductor Parameter Analyzer
SMU and PULSE Generator Expander

Model Number: Agilent 4155B/ Agilent 4156B/ Agilent 41501B

Product Options: This declaration covers all options of the above product

Conforms to the following product standards

EMC CISPR11(1990) / EN55011(1991) Group 1, Class A
IEC 801-2(1991) / EN50082-1(1992) 4kV CD, 8kV AD
IEC 801-3(1984) / EN50082-1(1992) 3V/m
IEC 801-4(1988) / EN50082-1(1992) 1kV Power Line / 5kV Signal Lines
IEC 1000-3-2(1995) / EN61000-3-2(1995)
IEC 1000-3-3(1994) / EN61000-3-3(1995)

Safety IEC 1010-1(1990)+A2 / EN61010-1(1993)
CSA C22 2 No.1010 1(1992)

Conformity / Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carries the CE-marking accordingly

Tokyo Japan, January 24, 2000


Toshiyuki Kawaji, QA Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor

HIGH VOLTAGE SHOCK HAZARD

The Agilent 4155B/4156B/41501B can force dangerous voltages (200 V for HPSMU, and 100 V for HRSMU and MPSMU) at the force, guard, and sense terminals. To prevent electric shock hazard, the following safety precautions must be observed during the use of the Agilent 4155B/4156B/41501B.

- Use a three-conductor ac power cable to connect cabinet (if used) and Agilent 4155B/4156B/41501B to an electric ground (safety ground).
- If you do not use Agilent 16442A Test Fixture, make sure to connect the INTLK terminal to a switch that turns off when the shielding box access door is opened.
- Confirm periodically that INTLK function works normally.
- Before touching the connections of the force, guard, and sense terminals, turn the Agilent 4155B/4156B/41501B off and discharge any capacitors whenever possible. If you do not turn the Agilent 4155B/4156B/41501B off, complete "all" of the following items, regardless of any Agilent 4155B/4156B/41501B settings.
 - Terminate measurement by pressing Stop key, confirm that the MEASUREMENT indicator is not lit.
 - Deactivate standby mode (if used) by pressing Standby key, confirm that the Standby indicator is not lit.
 - Confirm that the HIGH VOLTAGE indicator is not lit.
 - Open the shielding box access door (open the INTLK terminal).
 - Discharge any capacitors if the capacitance is connected to an SMU.
- Warn workers in the vicinity of the Agilent 4155B/4156B/41501B about dangerous conditions.

高電圧感電注意

Agilent 4155B/4156B/41501Bのフォース、ガードまたはセンス端子には、危険電圧 (HPSMUの場合最大 ± 200 Vdc、MPSMUまたはHRSMUの場合最大 ± 100 Vdc)が出力されることがあります。感電事故防止のため、必ず以下の事柄を守ってください。

- 3極電源ケーブルを使用して Agilent 4155B/4156B/41501Bを接地すること。
- Agilent 16442A テスト・フィクスチャ以外のフィクスチャ、あるいはプローバを使用する場合には、シールド・ボックスにインターロック回路を接続すること。
インターロック回路とは、シールド・ボックスの蓋を開いた時に Agilent 4155B/4156BのINTLK端子をオープンにすることができる回路のことを指します。
- インターロック機能が正常であることを定期的に確認すること。
- フォース、ガード、およびセンス端子からの接続部に触れる前に、Agilent 4155B/4156B/41501Bの電源を切ること。
また、測定系にキャパシタが接続されている場合、キャパシタを放電すること。
電源を切らない場合は、以下の事項を全て実施すること。
 - Stopキーを押し、MEASUREMENTインジケータが消灯していることを確認すること。
 - Standbyキーを押し、Standbyインジケータが消灯していることを確認すること。
 - 高電圧警告 (HIGH VOLTAGE) インジケータが消灯していることを確認すること。
 - シールド・ボックスの蓋を開ける (INTLK端子をオープンにする) こと。
 - キャパシタがSMUに接続されているならば、キャパシタを放電すること。
- 周囲のほかの作業者に対しても、高電圧危険に対する注意を徹底すること。

PRECAUTIONS POUR COMMOTION A HAUTE TENSION

Une tension dangereuse (max. \pm pour HPSMU; 200 Vdc, max. \pm pour HPSMU ou HRSMU; 100 Vdc) émanant du dispositif Agilent 4155B/4156B/41501B peut être sortie aux bornes de force, d'appareil de protection ou de détection. Les précautions suivantes doivent être observées contre commotion électrique accidentelle:

- Mettre à la terre le dispositif Agilent 4155B/4156B/41501B au moyen du câble d'alimentation tripolaire.
- En cas de hors service du dispositif d'essai, FIXTURE Agilent 16442A, connecter les bornes de verrouillage (INTLK) de façon à ce que soit ouverte lorsque le couvercle de la boîte de blindage est ouvert.
- Essayer périodiquement le fonctionnement normal de verrouillage.
- Avant de toucher la partie connexion à partir des bornes de force, d'appareil de protection et de détection, mettre hors tension le dispositif Agilent 4155B/4156B/41501B.
Et, en cas de condensateurs connectés au circuit de mesure, décharger ces condensateurs. Lorsque l'alimentation n'est pas mise hors tension, les 4 instructions suivantes doivent être exécutées:
 - Finir la mesure en appuyant sur la touche "STOP"; vérifier que l'indicateur "MEASUREMENT" n'est pas allumé.
 - Désactiver le mode "Standby" (si utilise) en appuyant sur la touche "Standby"; vérifier que l'indicateur "Standby" n'est pas allumé.
 - S'assurer que soit allumé l'indicateur d'alarme de la haute tension.
 - Ouvrir le couvercle de la boîte de blindage (Ouvrir les bornes de verrouillage).
 - En cas de condensateurs connectés à SMU, décharger les condensateurs.
- Alerter d'autres personnes autour de vous contre le danger de haute tension.

Achtung! Gefährliche Spannung

Von den Geräten Agilent 4155B/4156B/41501B können Spannungen an den Anschlüssen "Force, Guard und Sense" von bis zu 200 V ausgehen. Um elektrischem Schlag vorzubeugen, ist bei der Benützung der Geräte Agilent 4155B/4156B/41501B folgendes zu beachten:

- Erden Sie das Kabinett (falls verwendet) sowie die Geräte Agilent 4155B/4156B/41501B mittels dreiadrigter Netzleitungen.
- Wenn die Meßfassung, Agilent 16442A, zwar angeschlossen, jedoch nicht verwendet wird, schließen Sie die Verriegelungsklemme (INTLK) so an, daß bei geöffnetem Deckel die Stromzuführung zu Agilent 16442A auf jeden Fall unterbrochen wird.
- Vergewissern Sie sich regelmäßig daß die Verriegelungsfunktion korrekt arbeitet.
- Schalten Sie die Geräte Agilent 4155B/4156B/41501B aus, und entladen Sie alle Kapazitäten bevor Sie die Anschlüsse "Force, Guard und Sense" berühren. Falls Sie die Geräte Agilent 4155B/4156B/41501B nicht ausschalten, führen Sie unabhängig von den Geräteeinstellungen folgende Schritte durch:
 - Beenden Sie die gegenwärtige Messung durch Drücken der Stop Taste (die MEASUREMENT Leuchtdiode erlischt).
 - Deaktivieren Sie den Standby Modus (falls verwendet) durch Drücken der Standby Taste (die Standby Leuchtdiode erlischt).
 - Vergewissern Sie sich daß die Hochspannungswarnlampe erloschen ist.
 - Öffnen Sie den Deckel der Meßfassung Agilent 16442A (die Verriegelungsklemme (INTLK) öffnen).
 - Entladen Sie alle an SMUs angeschlossenen Kondensatoren (falls vorhanden).
- Informieren Sie Personen in unmittelbarer Nähe der Geräte Agilent 4155B/4156B/41501B über die Gefährlichkeit der bestehenden Hochspannung, und sichern Sie den Zugang zum Prüfplatz zum Schutz Dritter.

In This Manual

This manual provides information and instructions for installation, file operation, printer/plotter function, and what unrelated to the measurement and analysis, and consists of the following chapters. For the information about the measurement and analysis, refer to *User's Guide Measurement and Analysis*.

- **Introducing the 4155B/4156B**
This chapter describes overview of the 4155B/4156B.
- **Installation**
This chapter describes how to install the 4155B/4156B, accessories, and peripherals.
- **File Operations**
This chapter describes how to store or load the 4155B/4156B setup and measurement data.
- **Print/Plot Function**
This chapter provides information about the print/plot function.
- **System Page Organization**
This chapter provides information about the user interface page displayed on the 4155B/4156B screen by pressing the System key.
- **External Keyboard**
This chapter provides softkey maps and information about using an external keyboard (furnished with the 4155B/4156B).
- **Initial Settings**
This chapter provides information about user defined initial settings and default initial settings.
- **Specifications**
- **Accessories and Options**
- **If You Have A Problem**

Other Manuals

The following Agilent 4155B/4156B manuals are also available:

- **User's Guide Measurement and Analysis**

This manual provides information about measurement and analysis by using the 4155B/4156B, and consists of the following chapters:

- Measurement Units
- Measurement Mode
- Measurement Functions
- Making Measurement
- Analyzing Measurement Results
- Page Organization
- Data Variables and Analysis Function
- If You Have A Problem

- **Quick Start Guide**

This manual is mainly for beginners and provides brief instructions about using the 4155B/4156B.

- **Programmer's Guide**

This manual provides information about controlling the 4155B/4156B by remote control command via GPIB interface and Instrument BASIC, and consists of the following chapters:

- Using Instrument BASIC
- 4155B/4156B SCPI Programming
- 4155B/4156B FLEX Programming
- Running 4145A/B Program Directly on the 4155B/4156B
- ASP-Like IBASIC Programming

- **SCPI Command Reference**

This manual is a complete reference of the 4155B/4156B SCPI (Standard Commands for Programmable Instruments) Command Set.

- GPIB Command Reference

This manual is a complete reference of the 4155B/4156B FLEX Command Set and the 4145B Syntax Command Set.

- Sample Application Programs Guide Book

This manual introduces application measurement examples using the 4155B/4156B and the sample application program disk furnished with the 4155B/4156B.

- VXIplug&play Driver User's Guide

This manual provides information about VXIplug&play driver for the 4155B/4156B. This manual also introduces an application measurement example using the 4155B/4156B and the VXIplug&play driver.




Text Conventions

The following text conventions are used in this manual:



Screen Text	Represents text that appears on screen of the 4155B/4156B.
<i>Italic</i>	Refers to a related document, or is used for emphasis.

Contents

1. Introducing the 4155B/4156B

Overview	1-4
Measurement Unit Configurations	1-6
Front View of the 4155B/4156B	1-7
Rear View of the 4155B/4156B	1-11
	1-12
	1-13
Front and Rear View of the 41501A/B	1-14
	1-15

2. Installation

	2-2
Requirements	2-3
Power Requirements	2-3
Power Cable	2-3
 Line Fuse and Line Voltage Selector for the 41501A	2-5
Ventilation Requirements	2-5
Operating Environment	2-6
Storing/Shipping Environment	2-6
Cleaning	2-6
Inspection	2-7
To Inspect the 4155B/4156B and Accessories	2-7
To Check the 4155B/4156B Operation	2-8
To Execute Diagnostics and Calibration	2-10
Connecting the 41501A/B SMU/Pulse Generator Expander	2-11

Contents

Installing Accessories	2-12
To Install the 16442A Test Fixture	2-13
To Install the 16441A R-Box	2-18
To Install the 16440A SMU/Pulse Generator Selector	2-20
To Connect the 16440A Selector to the 4155B/4156B	2-26
To Connect the Measurement Cable to the Connector Plate	2-28
⚠	2-30
Mounting Connectors	2-31
⚠ To Make an Interlock Circuit	2-33
To Connect the GNDU Output	2-37
To Connect the SMU Output	2-38
To Connect the VSU/VMU/PGU Outputs	2-40
Connecting Instruments or Peripherals	2-41
To Connect GPIB Instruments or Peripherals	2-41
To Connect Parallel Peripherals	2-42
To Connect to a LAN	2-43
 3. File Operations	
Selecting a Mass Storage Device	3-4
Listing a File Catalog	3-5
Storing Setup or Results Data	3-6
Storing Results Data in Spreadsheet Format	3-8
Output Format for the ASCII SAVE Function	3-10
Output Examples	3-12
Loading Setup or Results Data	3-14
Changing a File Name	3-16
Removing a File/Directory	3-17
Copying a File	3-18

Contents

Creating a Directory on a Network File System	3-20
Changing the Working Directory	3-21
Initializing a Diskette	3-22
Backing Up a Diskette	3-23
 4. Print/Plot Function	
Output Formats	4-3
Differences Between PCL, HR PCL and HP-GL	4-4
Output Resolution	4-5
Supported Peripherals	4-6
Connecting Peripherals	4-7
Printing/Plotting Screen Images	4-8
Printing/Plotting Setup Data Lists	4-11
Printing/Plotting Measurement Data Lists	4-14
Printing/Plotting Measurement Data Graphs	4-17
Saving Screen Images	4-21
Saving Setup Data Lists	4-24
Saving Measurement Data Lists	4-28
Saving Measurement Data Graphs	4-32
Output Examples	4-37
Screen Dump Output	4-38
Setup Data List Output	4-40
Measurement Result List Output	4-42
Measurement Result Graph Output	4-44

Contents

5. System Page Organization	
Screen Structure	5-3
SYSTEM Screen Group	5-5
SYSTEM: FILER screen	5-6
SYSTEM: CONFIGURATION screen	5-28
SYSTEM: SELF-CALIBRATION/DIAGNOSTICS screen	5-29
SYSTEM: PRINT/PLOT SETUP screen	5-32
SYSTEM: COLOR SETUP screen	5-36
Screen Operation	5-39
Data Input or Edit	5-39
Blue front-panel key usage	5-40
Green front-panel key usage	5-41
Edit front-panel keys	5-42
Status Indicators	5-43
6. External Keyboard	
7. Initial Settings	
8. Specifications	
9. Accessories and Options	
10. If You Have A Problem	

Introducing the 4155B/4156B

Agilent 4155B/4156B is an electronic instrument for measuring and analyzing the characteristics of semiconductor devices. This one instrument allows you to perform *both* measurement *and* analysis of measurement results.

Following is summary of Agilent 4155B/4156B features.

- Measurement Capabilities

The 4155B/4156B has four highly accurate source/monitor units (SMUs), two voltage source units (VSUs), and two voltage measurement units (VMUs). The 4156B is designed for Kelvin connections and has high-resolution SMUs (HRSMUs), so the 4156B is especially suited for low resistance and low current measurements. You can measure voltage values with a resolution of 1 V by using the differential measurement mode of VMUs.

The 4155B/4156B can perform two types of measurements, sweep measurement and sampling measurement. The 4155B/4156B also provides knob sweep measurement function for quick sweep measurements executed by rotating the rotary knob on the front panel.

The 4155B/4156B can perform *stress* testing. That is, can force a specified dc voltage or current for the specified duration. Also, you can force ac stress by using pulse generator units (PGUs), which are installed in Agilent 41501A/B SMU/Pulse Generator Expander.

- Analysis Function

The 4155B/4156B provides a marker and two lines for analyzing the measurement results. The 4155B/4156B also provides the automatic analysis function which moves marker and lines at desired location and displays desired calculation results automatically after measurement is completed.

- Data storing

The 4155B/4156B allows you to store measurement setup information, measurement data, and instrument setting information on a 3.5-inch diskette using the built-in flexible disk drive, or on a NFS server via LAN.

The allowable disk formats are MS-DOS and HP LIF.

You can also use internal memory for temporary data storage. You can save up to four files in internal memory. You can quickly move information between the internal memory and the 4155B/4156B working memory.

Introducing the 4155B/4156B

- **Printing and plotting**

The 4155B/4156B allows you to print the setup data, measurement results and screen images on a printer or plotter that is connected to the 4155B/4156B via GPIB interface, or parallel I/O interface. The 4155B/4156B can also store a TIFF, PCL, or HP-GL file.

You can also use a remote printer via LAN to make hardcopies.

- **Remote control**

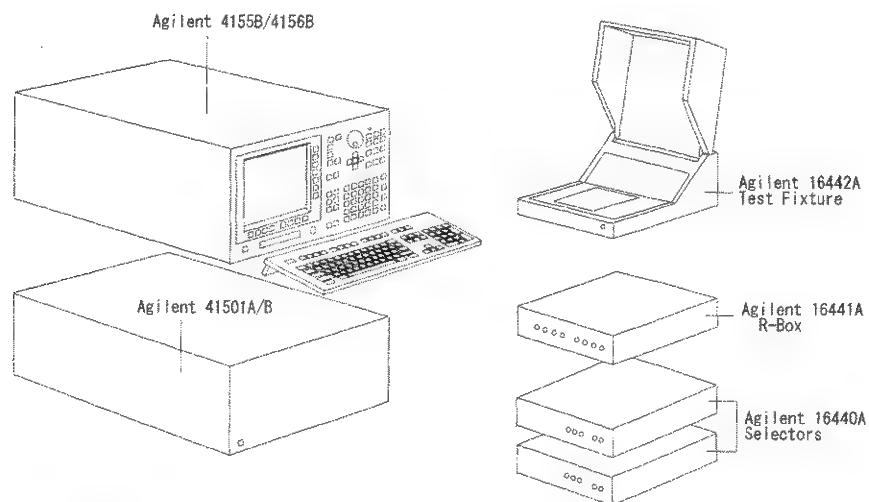
The 4155B/4156B can be controlled by an external controller via GPIB by using remote control commands. The 4155B/4156B provides the following command sets, so you can select the command set suitable for your application.

- 4155B/4156B SCPI (Standard Commands for Programmable Instruments) command set
- 4155B/4156B FLEX (Fast Language for Execution) command set
- 4145B syntax command set

Also the 4155B/4156B has internal Instrument BASIC, so you can develop and execute measurement programs by using the 4155B/4156B only, without using an external controller.

Introducing the 4155B/4156B Overview

Overview



The 4155B/4156B is a box type electronic measurement instrument with LCD display, flexible disk drive, operation keys, and interface connectors.

- Keyboard

You can connect a keyboard to the 4155B/4156B. So, you can operate this instrument by using a keyboard or the front-panel keys.

- Agilent 41501A/B SMU/Pulse Generator Expander

The 41501A/B SMU and Pulse Generator Expander contains pulse generator units (PGUs) and additional SMUs. The 41501A/B is attached to and controlled by the 4155B/4156B.

- Test Fixture

Agilent 16442A is the test fixture for the 4155B/4156B. You can mount your device under test (DUT) on the 16442A, and measure the device characteristics.

- Resistor Box

Agilent 16441A R-Box contains accurate 10 k Ω , 100 k Ω , and 1 M Ω resistors, and connection of these resistors is controlled by the 4155B/4156B. The 16441A is used to measure negative resistance and to prevent DUT damage when performing breakdown measurements.

Introducing the 4155B/4156B Overview

- SMU/PGU Selector

Agilent 16440A SMU/Pulse Generator Selector contains two switching circuits to connect the DUT to either an SMU or PGU. You can attach another 16440A to add two more switching circuits.

Measurement Unit Configurations

Agilent 4155B, 4156B, and 41501A/B are frames that contain the measurement units. The measurement units are installed before the product is shipped from factory. User cannot reconfigure the installed units.

- Agilent 4155B configuration:
 - four medium power source monitor units (MPSMUs).
 - two voltage source units (VSUs).
 - two voltage monitor units (VMUs).
- Agilent 4156B configuration:
 - four high resolution source monitor units (HRSMUs).
 - two voltage source units (VSUs).
 - two voltage monitor units (VMUs).

The 4156B has higher measurement resolution. For details about measurement range and resolution, refer to "Measurement Units" in the 4155B/4156B *User's Guide: Measurement and Analysis*.

- Agilent 41501A/B configuration:

The 41501A/B is attached to the 4155B/4156B at your site. See Chapter 2, "Installation," on how to install the 41501A/B.

The 41501A/B contains a ground unit (GNDU). In addition, you specify an option number according to desired units as follows:

Table 1-1

Configuration of the 41501A/B

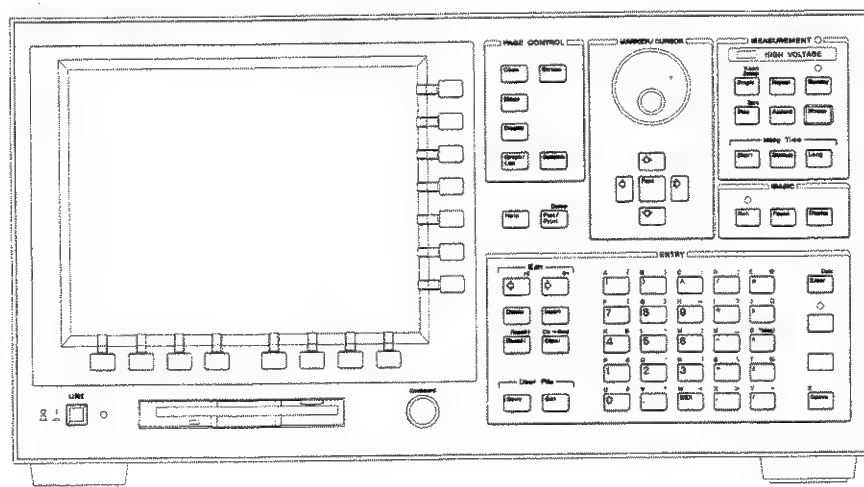
Unit	Agilent 41501A/B Option				
	402	410	412	420	422
One GNDU	yes	yes	yes	yes	yes
Two PGUs	yes		yes		yes
Two MPSMUs				yes	yes
One HPSMU ^a		yes	yes		

a. HPSMU: high power source monitor unit

Front View of the 4155B/4156B

Figure 1-1

Front View of the 4155B/4156B



- **LINE switch**
Use the LINE switch to turn analyzer on and off.
- **Flexible disk drive (FDD)**
Use 3.5 inch diskette to load or store the analyzer settings and measurement data.
- **Keyboard connector**
You can use an IBM PC/AT compatible keyboard to operate the 4155B/4156B. See Chapter 6, "External Keyboard."
- **Help key**
Pressing Help key displays the *help* screens.
- **Plot/Print key**
Pressing Print/Plot key prints the setup information and measurement results to your plotter, printer, or file, TIFF, PCL, or HP-GL file.

If you press green key and Print/Plot key, the screen image is dumped to plotter, printer, or file.

Introducing the 4155B/4156B

Front View of the 4155B/4156B

- **PAGE CONTROL** key group

Page Control keys are used to change the display screens.

Chan key	Moves to CHANNELS screen group. You define channels, user functions, and user variables.
Meas key	Moves to MEASURE screen group. You set the output parameters, measurement parameters, and so on.
Display key	Moves to DISPLAY screen group. You set the result display format, auto analysis definitions, and so on.
Graph/List key	Moves to GRAPH/LIST screen group. This softkey toggles between GRAPH and LIST screens.
Stress key	Moves to STRESS screen group. You define the stress channels, set the stress parameters, and monitor the stress forcing.
System key	Moves to SYSTEM screen group. You operate on diskette files, set up plotting and printing environment, define colors of the display, and so on.

- **MARKER/CURSOR** key group

Rotary knob and arrow keys of the Marker/Cursor key group are used to move the marker and cursor.

Rotary knob	Moves the marker, or increases or decreases setup value.
Arrow keys	Up, Down, Left, and Right. Moves field pointer or cursor.
Fast key	Moves the marker or cursor faster. When you rotate the rotary knob or press the arrow keys with holding Fast key down, the marker or cursor moves faster.

Introducing the 4155B/4156B
Front View of the 4155B/4156B

- **MEASUREMENT key group**

Measurement keys control the measurement, stress, and integration time.

Single key	Executes the measurement once, then returns to the idle state (or standby state if standby is enabled for the channel) after the measurement is finished. Measurement data is updated, so data of previous measurement is lost. Pressing the green key, then Single key starts knob sweep measurement.
Repeat key	Starts and repeats the measurement continuously. Measurement data is updated, so data of previous measurement is lost. To stop the measurement, press Stop key.
Append key	Executes the measurement once, then returns to idle state (or standby state if standby is enabled for the channel) after measurement is finished. Measurement data is appended to data of previous measurement.
Stop key	Stops the measurement or stress. Standby enabled channels return to standby state, and other channels return to idle state.
Standby key	Toggles between the standby enabled (Standby indicator is lit) and disabled states. If Standby indicator is lit, then STBY ON channels change to standby state (instead of idle state) when measurement or stress finishes. Stop key has no affect on standby state.
Stress key	Forces the specified stress. The guide around this key prevents you from accidentally pressing the Stress key.
Short, Medium, and Long keys	Sets the integration time to SHORT, MEDIUM, or LONG, respectively.

- **MEASUREMENT indicator**

This indicator lights when the 4155B/4156B is in the measurement state.

- **HIGH VOLTAGE indicator**

This indicator lights when a unit forces more than 40 V.

Introducing the 4155B/4156B

Front View of the 4155B/4156B

- Standby indicator

This indicator lights when the 4155B/4156B is standby enabled, which means that the channels that are standby enabled (STBY ON) will return to the standby state after the measurement is finished.

- IBASIC key group

IBASIC keys control the IBASIC program execution.

Run key Starts the IBASIC program that is in memory. The indicator is on during program execution.

Pause key Pauses the IBASIC program execution.

Display key Toggles between the IBASIC screen and measurement screen.

- Run indicator

When an IBASIC program is running, this indicator lights.

- ENTRY key group

You enter or modify data such as output values, comments, and variable names.

Character keys Are used to enter alphanumeric and special characters.

Enter key After you enter desired characters into the data entry field, press this key. The characters are entered at the field pointer location. Also, you can use the green key to calculate the value of the data entry field. For example, if you press 4 * 6 green key and Enter key, the result (24) appears.

Blue key Changes entry mode to blue-key shift mode, and lights the indicator. In this mode, you can enter the blue characters that are printed above the keys. Pressing blue key again changes to normal mode. Indicator turns off.

Green key Changes entry mode to green-key shift mode. This mode is effective for the next pressed key, then changes back to normal mode.

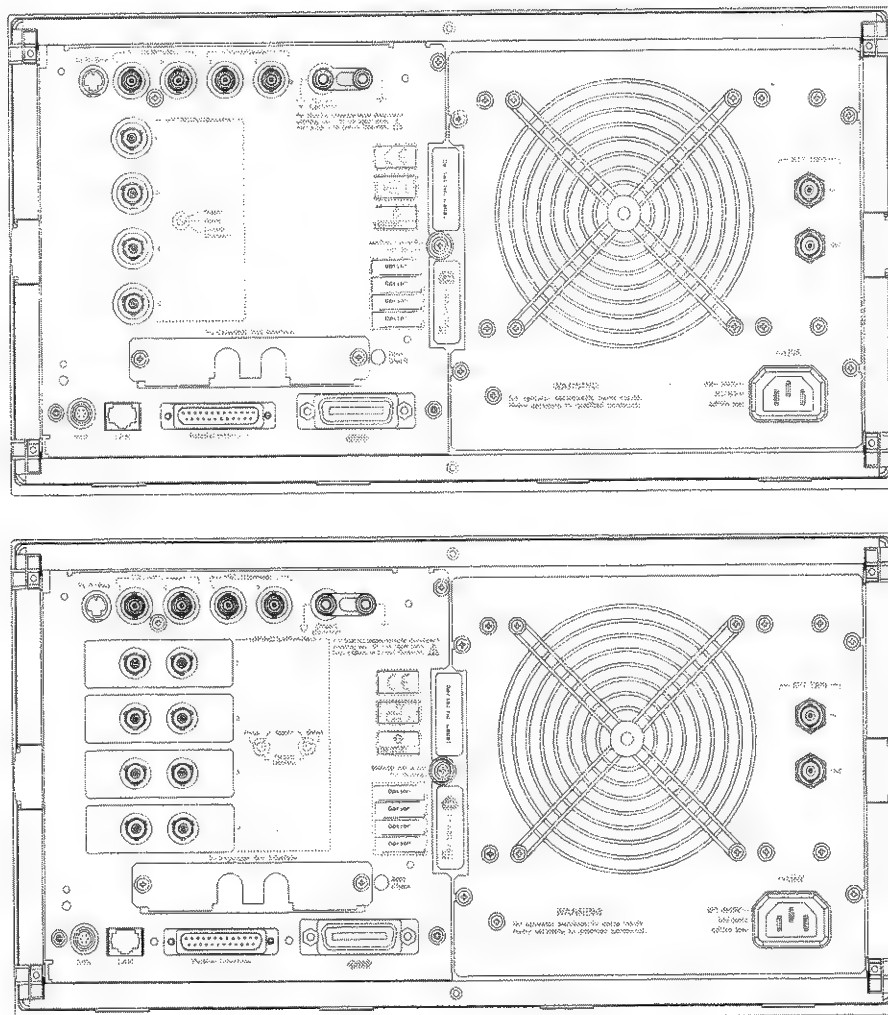
Edit keys Are used to edit the characters in the data entry field.

User File keys Are used to operate quickly on a file in diskette, internal memory or a directory on a NFS server. Pressing Save key moves into the filer's SAVE function, and pressing Get key moves into the filer's GET function.

Rear View of the 4155B/4156B

Figure 1-2

Rear View of the 4155B/4156B



Introducing the 4155B/4156B
Rear View of the 4155B/4156B

- To R-Box terminal

"To R-Box" terminal is a 10-pin connector. To use R-Box, connect this terminal to control terminal of Agilent 16441A R-Box.

- VSU terminals

VSU output terminals are BNC connectors. To use VSUs, connect these terminals to VSU terminals of Agilent 16442A or connector plate.

- VMU terminals

VMU input terminals are BNC connectors. To use VMUs, connect these terminals to VMU terminals of the 16442A or connector plate.

- SMU terminals

The 4155B has four triaxial connectors. The 4156B has eight triaxial connectors, and you can use Kelvin connections. When you use the 16442A test fixture and Kelvin connections, up to 3 SMUs can be connected to the 16442A test fixture.



- Circuit Common () and Frame ground () terminals

For floating measurement, remove the shorting bar (Agilent part number 5000-4206).

WARNING

Do not float the Circuit Common terminal at voltages greater than ± 42 V referenced to frame ground. Failure to heed this warning may result in damage to Agilent 4155B/4156B.

- To Expander Box Interface

When you use Agilent 41501A/B, you insert the board for the 41501A/B into this interface.

- Zero Check terminal

Ground reference point of the 4155B/4156B.

- Serial number

You need this *serial number* when using the telephone assistance program (Agilent Technologies HelpLine).

Introducing the 4155B/4156B
Rear View of the 4155B/4156B



- Intlk terminal

Used in conjunction with interlock function of the 4155B/4156B. If the Intlk terminal is open, maximum SMU output is limited to 40 V. Be sure to connect this terminal to the 16442A test fixture or connector plate before performing measurement. If you use connector plate, you must install interlock circuit. For details on how to install the interlock circuit, see “To Make an Interlock Circuit” in Chapter 2.

WARNING

Dangerous voltage of up to the maximum voltage of SMUs may be present at force, guard, and sense terminals if the interlock terminal is shorted.

- LAN interface

RJ45 connector. Ethernet IEEE 802.3 10BASE-T for a 10M bps CSMA/CD local area network.

The 4155B/4156B can be a NFS cluster, and can use a remote printer to make hardcopies.

- Parallel interface

25-pin parallel I/O interface port for connecting peripheral such as a Centronics parallel printer.

- GPIB interface

Use Agilent 10833A/B/C/D GPIB cable.

- Ext Trig terminals

Two BNC connectors: one for trigger input, and one for trigger output.

- LINE input receptacle

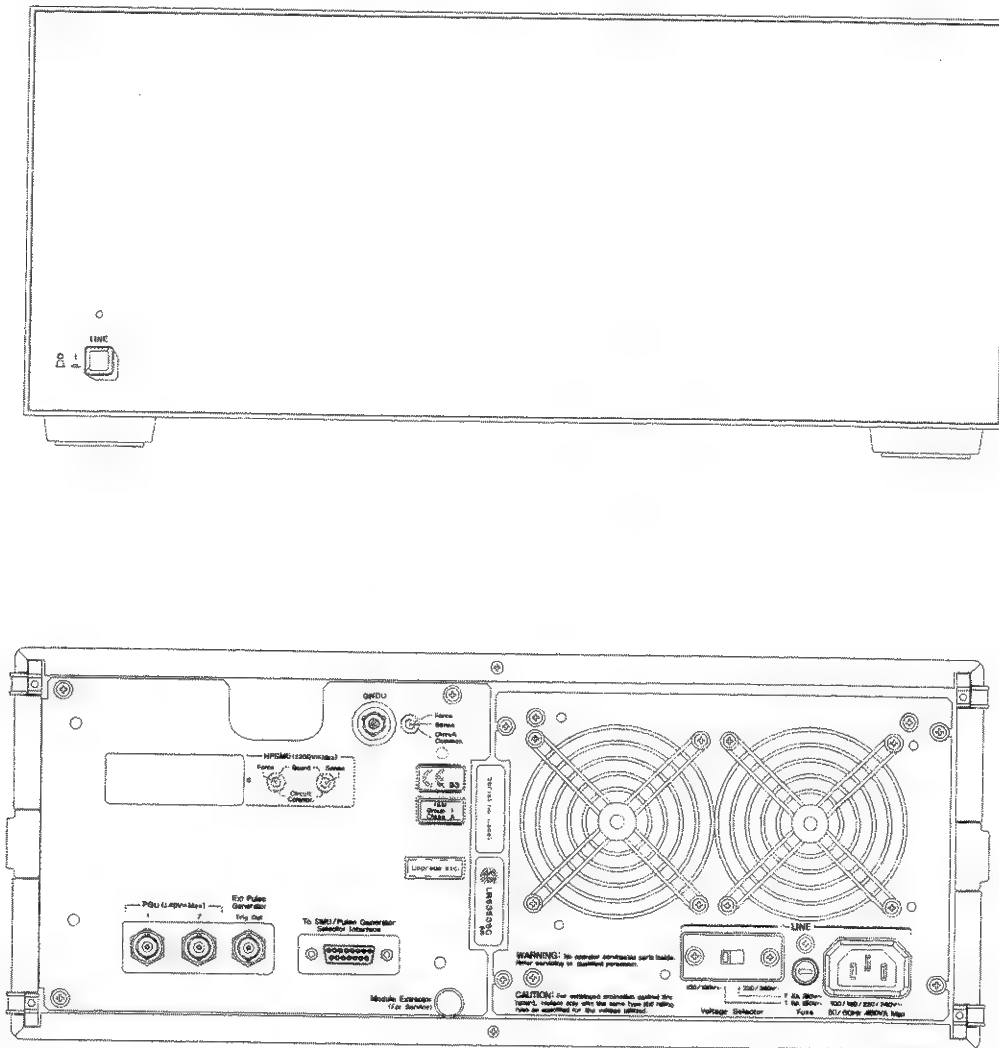
AC power cable is connected to this receptacle.

Introducing the 4155B/4156B
Front and Rear View of the 41501A/B

Front and Rear View of the 41501A/B

Figure 1-3

Front and Rear View of the 41501A



Introducing the 4155B/4156B
Front and Rear View of the 41501A/B



- LINE switch

Use the LINE switch to turn the 41501A/B on and off. *You must turn on the 41501A/B before turning on the 4155B/4156B.*

- Fuse (only for 41501A)

Use the following fuse:

Line	Fuse type	Agilent part number
100/120 Vac	UL/CSA T 8A, 250 Vac	2110-0383
220/240 Vac	UL/CSA T 4A, 250 Vac	2110-0014

- Voltage Selector (only for 41501A)

Voltage selector must be in proper position. Line voltage and position are:

Line Voltage	Position
90 — 132 Vac	left
198 — 264 Vac	right

- LINE input receptacle

AC power cable is connected to this receptacle.

- Serial number

The 41501A/B has its own serial number. You need this *serial number* when using the telephone assistance program (Agilent Technologies HelpLine).

- GNDU connector

The GNDU connector is a triaxial connector: inner conductor is sense, middle conductor is force, and outer conductor is circuit common.

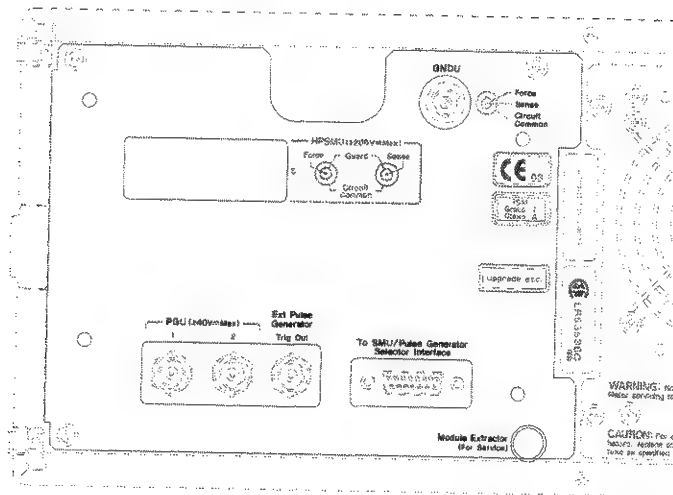
Introducing the 4155B/4156B
Front and Rear View of the 41501A/B

Option 402

The 41501A/B Option 402 has two PGUs.

Figure 1-4

Rear View of the 41501A/B Option 402



- **PGU output terminals**
BNC connectors. Inner conductor is force and outer conductor is circuit common.
- **Ext Pulse Generator Trig Out terminal**
Trigger pulses synchronized with PGU pulses are output. This trigger is used to synchronize the PGU pulse outputs with external pulse generators. You *cannot* change the parameters of this trigger. For details about PGU trigger, see "Measurement Functions" in the 4155B/4156B *User's Guide: Measurement and Analysis*.
- **To SMU/Pulse Generator Selector Interface**
D-SUB 15-pin connector is used to control the 16440A SMU/pulse generator selector.

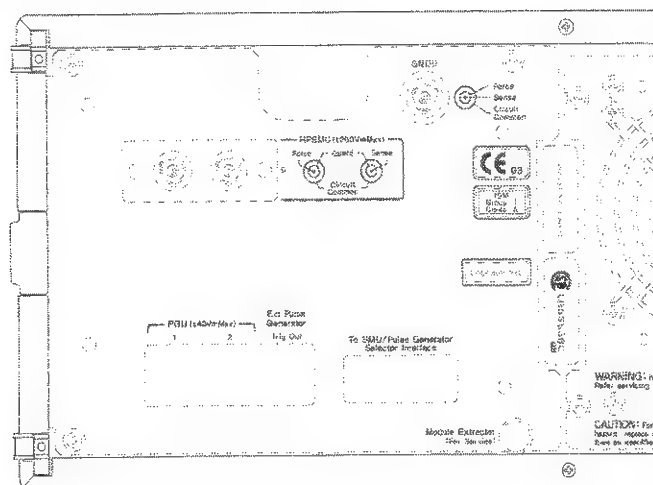
Introducing the 4155B/4156B
Front and Rear View of the 41501A/B

Option 410

The 41501A/B Option 410 has one HPSMU.

Figure 1-5

Rear View of the 41501A/B Option 410



- HPSMU terminals

There are two triaxial connectors for Kelvin connections: one is for force and the other is for sense. For SMU5.

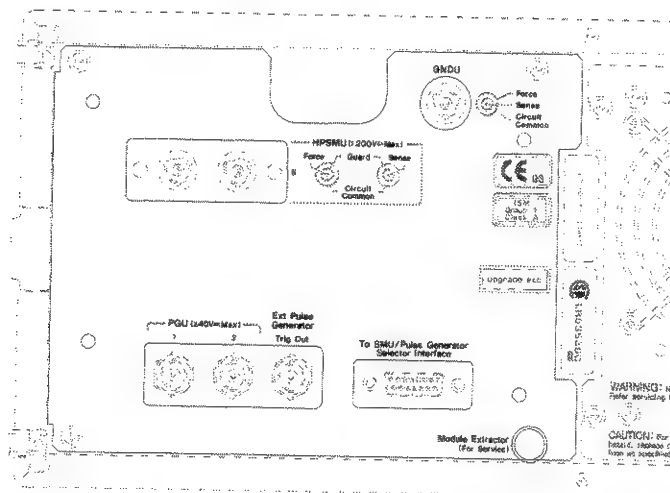
Introducing the 4155B/4156B Front and Rear View of the 41501A/B

Option 412

The 41501A/B Option 412 has one HPSMU and two PGUs.

Figure 1-6

Rear View of the 41501A/B Option 412



- **HPSMU terminals**

There are two triaxial connectors for Kelvin connections: one is for force and the other is for sense. For SMU5.

- **PGU output terminals**

BNC connectors. Inner conductor is force and outer conductor is circuit common.

- **Ext Pulse Generator Trig Out terminal**

Trigger pulses synchronized with PGU pulses are output. This trigger is used to synchronize the PGU pulse outputs with external pulse generators. You *cannot* change the parameters of this trigger. For details about PGU trigger, see "Measurement Functions" in the 4155B/4156B *User's Guide: Measurement and Analysis*.

- **To SMU/Pulse Generator Selector Interface**

D-SUB 15-pin connector is used to control the 16440A SMU/pulse generator selector.

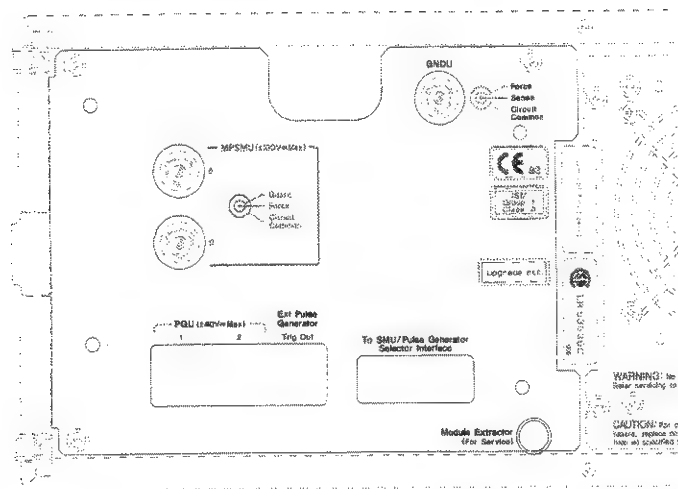
Introducing the 4155B/4156B
Front and Rear View of the 41501A/B

Option 420

The 41501A/B Option 420 has two MPSMUs.

Figure 1-7

Rear View of the 41501A/B Option 420



- MPSMU terminals

Two MPSMUs are installed and each MPSMU has a triaxial connector. These connectors are not designed for Kelvin connections. For SMU5 and SMU6.

Option 422

Figure 1-8

- 1-20**

Installation

This chapter describes the requirements and procedures to install Agilent 4155B/4156B. It contains the following information:

- requirements
- inspection
- connecting the 41501A/B
- installing accessories
- mounting connectors
- connecting peripherals



WARNING

There are potentially hazardous voltages (200 V for HPSMU, and 100 V for HRSMU and MPSMU) present at the Force, Guard, and Sense terminals of the 4155B/4156B. To prevent electrical shock, the following safety precautions must be observed during the use of the 4155B/4156B.

- Use a three-conductor ac power cable to connect the cabinet (if used) and the 4155B/4156B to an electrical ground (safety ground).
- If you do *not* use the 16442A test fixture, you must connect the Intlk terminal to a switch that turns off when the shielding box access door is opened.
- Confirm periodically that the interlock function works normally.
- Before touching the connections on the Force, Guard, and Sense terminals, turn the 4155B/4156B off and discharge any capacitors. If you do *not* turn the 4155B/4156B off, complete *all* of the following items, regardless of the 4155B/4156B settings.
 - Terminate measurement by pressing Stop key, confirm that the MEASUREMENT indicator is not lit.
 - Deactivate standby mode (if used) by pressing Standby key, confirm that the Standby indicator is not lit.
 - Confirm that the HIGH VOLTAGE indicator is not lit.
 - Open the shielding box access door (open the Intlk terminal).
 - Discharge any capacitors connected to an SMU.
- Warn persons working around the 4155B/4156B about dangerous conditions.

Requirements

This section contains information on:

- power requirements
- power cables
- line fuse and line voltage selectors (for the 41501A)
- ventilation requirements
- operating environment
- storing/shipping environment
- cleaning

Power Requirements

The 4155B/4156B can operate from any single-phase ac power source supplying 90 to 264 V at 47 to 63 Hz. The maximum power consumption is 450 VA for the 4155B/4156B/41501A, and 350 VA for the 41501B. For details, see Chapter 8.

Power Cable

CAUTION

Before applying ac line power to the 4155B/4156B or the 41501A/B, ensure that the correct power cable is used.

In accordance with international safety standards, this instrument is equipped with a three-prong power cable. When connected to an appropriate ac power outlet, this cable grounds the instrument frame. The type of power cable shipped with each instrument depends on the country of destination. Refer to the following table for the Agilent part numbers of the power cables available.

If the plug on the cable does not fit the power outlet, or the cable is to be attached to a terminal block, cut the cable at the plug end and re-wire it. This work should be performed by a qualified electrician, observing all local electrical codes.













The color coding used in the cable will depend on the cable supplied. If a new plug is to be connected, it must meet local safety requirements and include the following features:

- adequate load-carrying capacity (see Chapter 8)
- ground connection
- cable clamp

Installation Requirements

WARNING

For protection from electrical shock, do *not* interrupt the power cable ground.

 <ul style="list-style-type: none"> • Plug: BS 1363/A, 250 V, 10 A • Cable: 8120-1351 	 <ul style="list-style-type: none"> • Plug: AS 3112, 250 V, 10 A • Cable: 8120-1369 	 <ul style="list-style-type: none"> • Plug: CEE 7 Standard Sheet VII, 250 V, 10 A • Cable: 8120-1689
 <ul style="list-style-type: none"> • Plug: NEMA 5-15P, 125 V, 10 A • Cable: 8120-1378 	 <ul style="list-style-type: none"> • Plug: NEMA 6-15P, 250 V, 6 A • Cable: 8120-0698 	 <ul style="list-style-type: none"> • Plug: SEV Type 12, 250 V, 10 A • Cable: 8120-2104
 <ul style="list-style-type: none"> • Plug: SR 107-2-D, 250 V, 10 A • Cable: 8120-2956 	 <ul style="list-style-type: none"> • Plug: IEC 83-B1, 250 V, 10 A • Cable: 8120-4211 	 <ul style="list-style-type: none"> • Plug: JIS C 8303, 125 V, 12 A • Cable: 8120-4753
 <ul style="list-style-type: none"> • Plug: Argentine Resolution 63, Annex IV, 250 V, 10 A • Cable: 8120-6870 	 <ul style="list-style-type: none"> • Plug: CEI 23-16, 250 V, 10 A • Cable: 8120-6978 	 <ul style="list-style-type: none"> • Plug: GB 1002, 250 V, 10 A • Cable: 8120-8376



Line Fuse and Line Voltage Selector for the 41501A

Before applying ac line power to the 41501A, verify that the correct line fuse is installed in the fuse holder and the line voltage selector is set correctly.

Line	Fuse Type	Agilent Part Number
100/120 Vac	UL/CSA T 8A, 250 Vac	2110-0383
220/240 Vac	UL/CSA T 4A, 250 Vac	2110-0014

WARNING

Replace the line fuse only with the same type and rating. Do *not* use repaired fuses, and do *not* short circuit the fuse holder.

The line voltage selector switch is set at the factory. Verify the voltage selector setting before applying ac line power to the 41501A. The line voltage selector switch is located on the rear panel of the 41501A

Line Voltage	Position
90 — 132 Vac	left
198 — 264 Vac	right

Ventilation Requirements

The 4155B/4156B has one cooling fan, and the 41501A/B has two cooling fans. To ensure adequate airflow, make sure that there is sufficient clearance around the cooling fans: 6 inches (150 mm) behind, 3 inches (70 mm) on the sides, and 0.5 inch (12 mm) above and below.

If the airflow is restricted, the internal operating temperature will be higher. This may reduce the instrument's reliability, or cause the thermal-protection circuits to turn the instrument off.

Installation Requirements

Operating Environment

The 4155B/4156B and the 41501A/B are specified to operate within the following environmental conditions:

Temperature:	10 °C to 40 °C (with using flexible disk drive) 5 °C to 40 °C (without using flexible disk drive)
Humidity:	20 % to 80 % RH (with using flexible disk drive) 15 % to 80 % RH (without using flexible disk drive) non-condensing and wet bulb temperature ≤ 29 °C
Altitude:	0 to 2000 m

Storaging/Shipping Environment

The 4155B/4156B and the 41501A/B are specified to store/ship within the following environmental conditions:

Temperature:	-22 °C to 60 °C
Humidity:	5 % to 90 % RH, non-condensing and wet bulb temperature ≤ 39 °C
Altitude:	0 to 4600 m

Cleaning

To prevent electrical shock, disconnect the 4155B/4156B and 41501A/B from mains before cleaning. Use a dry cloth to clean the external case parts.

Inspection

This section describes what to do when you receive the 4155B/4156B and accessories.

1. Inspect the shipment.
2. Verify the 4155B/4156B operation.

To maintain the 4155B/4156B and 41501A/B measurement accuracy specifications, perform calibration and adjustments once a year.

To Inspect the 4155B/4156B and Accessories

Perform the following inspections when the 4155B/4156B and accessories arrive at your site.

- Before unpacking any components, inspect all boxes for any signs of damage that might have occurred during shipment, such as:
 - dents
 - scratches
 - cuts
 - water marksIf you suspect any damage, notify your local Agilent Technologies sales or service office.
- When you open the boxes that contain the 4155B/4156B and accessories, check the components against the contents lists attached to the boxes.
If anything is missing, notify your local Agilent Technologies sales or service office.

Installation
Inspection

To Check the 4155B/4156B Operation

1. Make sure that the line switches are set to off.
2. If the 41501A/B will be used with the 4155B/4156B, connect the 41501A/B as shown in "Connecting the 41501A/B SMU/Pulse Generator Expander" on page 2-11.
3. On the 4155B/4156B, make sure that the Circuit Common terminal is connected to the frame ground terminal by a shorting-bar.

WARNING

If the Circuit Common terminal is *not* connected to the frame ground terminal, a potential shock hazard exists.

4. Connect the power cable from the 4155B/4156B to an ac power outlet. If the 41501A/B will be used, connect the power cable from the 41501A/B to the outlet.
5. If the 41501A/B is installed, press the LINE button to turn the instrument on.
6. Press the LINE button to turn the 4155B/4156B on. The initialization screen will appear on the display of the instrument.
7. After the initialization is finished, the CHANNELS: CHANNEL DEFINITION screen will appear as shown in the figure below.

CHANNELS: CHANNEL DEFINITION
94 JAN01 01:30PM

*MEASUREMENT MODE
SWEEP

*CHANNELS

UNIT	VNAME	MEASURE			STBY	SERIES RESISTANCE
		I/NAME	MODE	FCTN		
SMU1:MP	V1	I1	COMMON	CONST		
SMU2:MP	V2	I2	I	VAR2		
SMU3:MP	V3	I3	V	VAR1		
SMU4:MP	V4	I4	V	CONST		
VSU1	VSU1	-----	V	CONST		
VSU2	VSU2	-----	V	CONST		
VMU1	VMU1	-----	V	-----		
VMU2	VMU2	-----	V	-----		

SWEEP

CHANNEL DEF	USER FCTN	USER VAR					
----------------	--------------	-------------	--	--	--	--	--

B

--	--	--	--	--	--	--	--

NEXT
PAGE

8. Make sure that the units displayed in the UNIT column match the units installed.

The following table shows the displayed units in the UNIT column:

4155B	4156B	Additional Units by Using 41501A/B Expander				
SMU1:MP	SMU1:HR	(Opt. 402)	(Opt. 410)	(Opt. 412)	(Opt. 420)	(Opt. 422)
SMU2:MP	SMU2:HR	PGU1	SMU5:HP	SMU5:HP	SMU5:MP	SMU5:MP
SMU3:MP	SMU3:HR	PGU2	GNDU	PGU1	SMU6:MP	SMU6:MP
SMU4:MP	SMU4:HR	GNDU		PGU2	GNDU	PGU1
VSU1	VSU1			GNDU		PGU2
VSU2	VSU2					GNDU
VMU1	VMU1					
VMU2	VMU2					

9. If the 41501A/B units are *not* displayed in the UNIT column, turn off the 4155B/4156B and the 41501A/B. Make sure that the 41501A/B interface board is firmly inserted into the 4155B/4156B. Turn on the 41501A/B, then turn on the 4155B/4156B.
10. Press the System key on the front panel, then select MISCELLANEOUS softkey. Confirm that the POWER LINE FREQUENCY is correct for your site. If not, select the correct softkey.

When you turn on the 4155B/4156B, the unit will execute a power-on self-test. If no error message is displayed on the screen, the 4155B/4156B is operating correctly.

If a problem occurs, see Chapter 10.

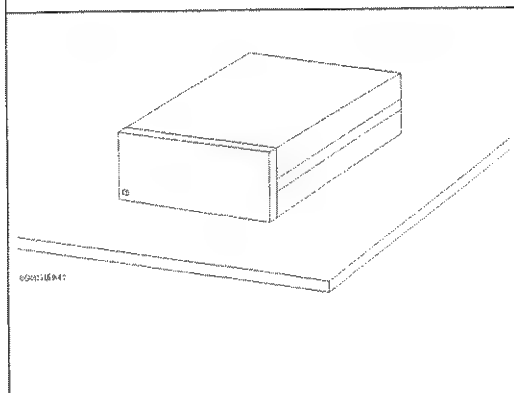
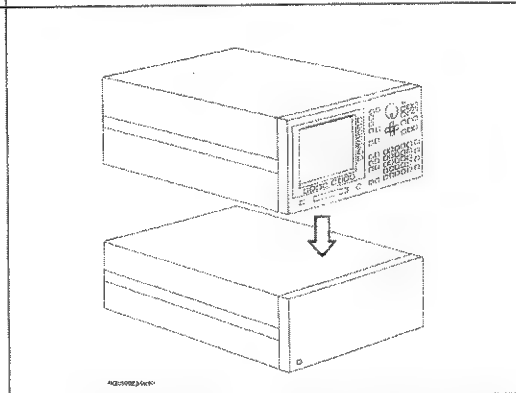
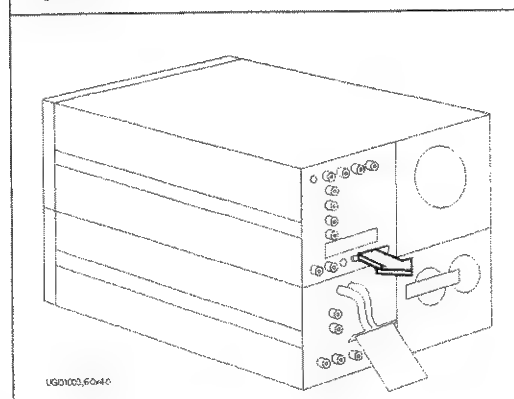
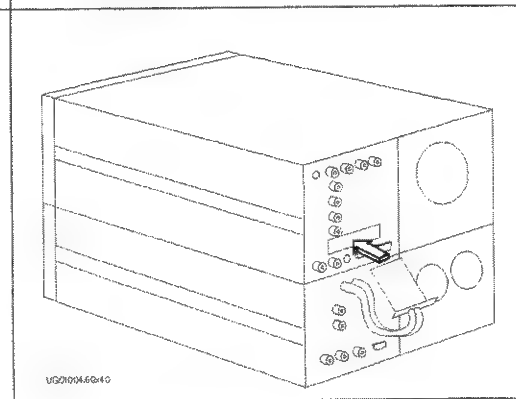
- Installation
- Inspection

To Execute Diagnostics and Calibration

You can execute diagnostics and/or calibration to verify the operation of the 4155B/4156B.

1. Press System key, then CALIB/DIAG softkey.
The SYSTEM: SELF-CALIBRATION/DIAGNOSTICS screen is displayed.
2. Disconnect all cables from the measurement terminals on the 4155B/4156B rear panel.
3. If you want to execute both diagnostics and calibration, select DIAG SELFTST ALL softkey.
4. If you want to execute calibration only, select CALIB ALL softkey.
5. To stop the diagnostics or calibration, select STOP softkey.

Connecting the 41501A/B SMU/Pulse Generator Expander

1. Place the 41501A/B on your workbench.	2. Place the 4155B/4156B on top of the 41501A/B.
 <p>Diagram showing the 41501A/B unit placed on a workbench. The unit is a rectangular box with a blank front panel. A small label '020115B-01' is visible on the bottom left of the front panel.</p>	 <p>Diagram showing the 4155B/4156B unit being placed on top of the 41501A/B unit. The 4155B/4156B unit has a control panel with a screen and various buttons. A downward arrow indicates the placement. A small label '4155B/4156B' is visible on the bottom left of the 4155B/4156B unit.</p>
3. Remove the blank panel labeled "To Expander Box Interface" from the rear panel of the 4155B/4156B.	4. Insert the 41501A/B interface board into the 4155B/4156B, then attach it with the thumbscrews.
 <p>Diagram showing the 4155B/4156B unit with the blank panel removed from the rear panel. The rear panel has several ports and a circular opening. A small label 'UG01001.60-01' is visible on the bottom left of the rear panel.</p>	 <p>Diagram showing the 41501A/B interface board inserted into the 4155B/4156B unit and secured with thumbscrews. The interface board is a rectangular board with various connectors. A small label 'UG01001.60-01' is visible on the bottom left of the interface board.</p>

WARNING

The 4155B/4156B, together with the 41501A/B, weights about 37 kg (81.8 lb). The 4155B/4156B is not anchored to the 41501A/B. Use caution when handling.

Installing Accessories

This section describes how to install the 4155B/4156B and accessories. Additional information regarding airflow can be found in the “Ventilation Requirements” on page 2-5.

This section describes how to:

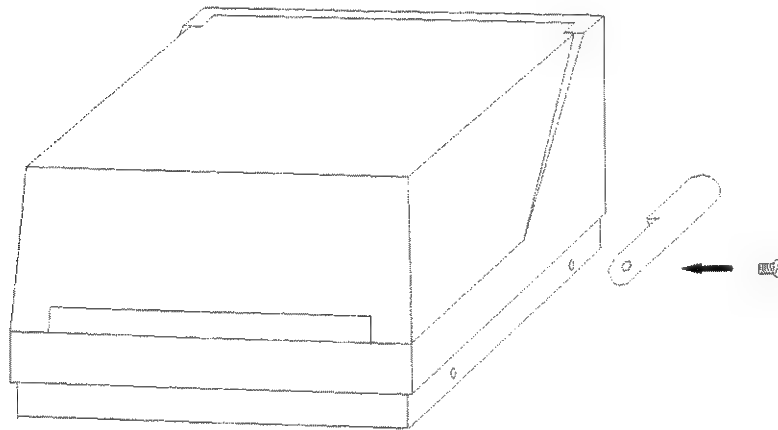
- install the 16442A test fixture
- install the 16441A R-box
- install the 16440A SMU/pulse generator selector
- connect the 16440A to the 4155B/4156B
- connect a measurement cable to a connector plate

When you install a keyboard, connect the keyboard to the keyboard interface on the front-panel *before* switching on the 4155B/4156B. The 4155B/4156B recognizes the keyboard during the power-on self-test.

To Install the 16442A Test Fixture

Before performing this procedure, turn off the 4155B/4156B and 41501A/B.

When you use the 16442A test fixture without the 16441A R-box or the 16440A selector, you can stabilize the 16442A as shown in the figure below.



1. Put a stabilizer on both sides of the test fixture.
2. Attach each stabilizer to the unit with a flathead screw.

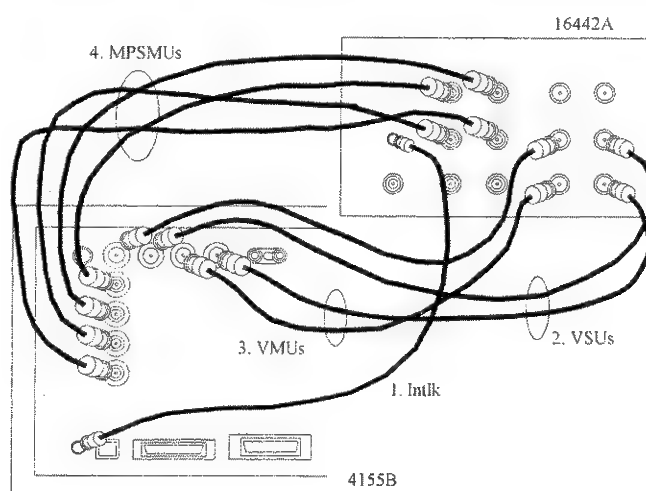
Installation
Installing Accessories

Connecting the 4155B and the 16442A test fixture

Connect the 4155B and the 16442A as shown below.

CAUTION

To prevent electrical shock during use, be sure to connect the interlock cable.



4155B Terminals	16442A Terminals	Cable
Intlk	Intlk	3 m or 1.5 m Interlock Cable
VSU	VSU	3 m or 1.5 m Coaxial Cable
VMU	VMU	3 m or 1.5 m Coaxial Cable
MPSMU	SMU	3 m or 1.5 m Triaxial Cable

WARNING

There are potentially hazardous voltages of up to ± 100 V at the Force and Guard terminals. To prevent electrical shock, do *not* expose these lines.

CAUTION

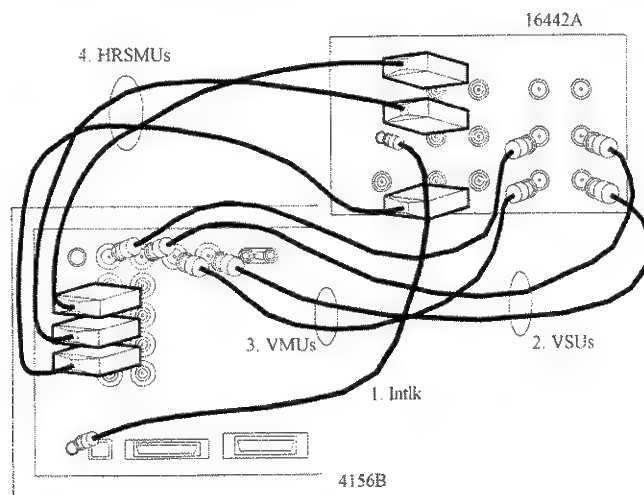
Never connect the Guard terminal to any output, including circuit common, frame ground, or any other guard terminal. Doing so will damage the SMU.

Connecting the 4156B and the 16442A test fixture

Connect the 4156B and the 16442A as shown below.

CAUTION

To prevent electrical shock during use, be sure to connect the interlock cable.



4156B Terminals	16442A Terminals	Cable
Intlk	Intlk	3 m or 1.5 m Interlock Cable
VSU	VSU	3 m or 1.5 m Coaxial Cable
VMU	VMU	3 m or 1.5 m Coaxial Cable
HRSMU	SMU1 and SMU2	3 m or 1.5 m Kelvin Triaxial Cable
	SMU3 and SMU4	
	SMU5 and SMU6	

WARNING

There are potentially hazardous voltages of up to ± 100 V at the Force, Sense, and Guard terminals. To prevent electrical shock, do *not* expose these lines.

CAUTION

Never connect the Guard terminal to any output, including circuit common, chassis ground, or any other guard terminal. Doing so will damage the SMU.

Installation
Installing Accessories

Connect the 41501A/B measurement terminals to the 16442A input as follows:

41501A/B Terminals	16442A Terminals	Cable
GNDU	GNDU	3 m or 1.5 m GNDU Cable
PGU	PGU	3 m or 1.5 m Coaxial Cable
MPSMU	SMU	3 m or 1.5 m Triaxial Cable
HPSMU	SMU1 and SMU2	3 m or 1.5 m Kelvin Triaxial Cable
	SMU3 and SMU4	
	SMU5 and SMU6	

WARNING

Use Agilent 16493H GNDU cable to connect the GNDU to a test fixture or a connector plate. Do *not* use the triaxial cable. The GNDU cable is rated for up to 1.6 A, but the maximum current rating of the triaxial cable is 1 A.

WARNING

There are potentially hazardous voltages of up to ± 200 V at the Force, Sense, and Guard terminals. To prevent electrical shock, do *not* expose these lines.

CAUTION

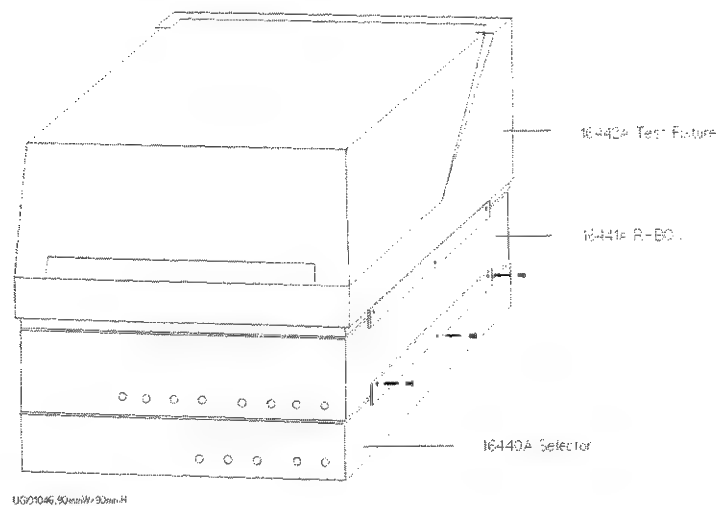
Never connect the Guard terminal to any output, including circuit common, chassis ground, or any other guard terminal. Doing so will damage the SMU.

Installation

Installing Accessories

Installing the 16442A test fixture with other accessories

The 16442A test fixture can be installed with an 16441A R-box, 16440A selector, or both. The following figure shows how to attach the 16442A to other accessories.



Installation
Installing Accessories

To Install the 16441A R-Box

Before installing the 16441A R-box, turn off the 4155B/4156B and 41501A/B.

1. Connect the To R-Box terminal on the 4155B/4156B to the Control terminal on the 16441A rear panel using a 3.0 m or 1.5 m control cable.
2. Connect the instrument measurement terminals to the 16441A input terminals as follows:

Instrument terminals	16441A Input	Cable
4155B MPSMU	Input Force	3 m or 1.5 m Triaxial Cable
4156B HRSMU	Input (Force/Sense)	3 m or 1.5 m Kelvin Triaxial Cable
41501A/B MPSMU	Input Force	3 m or 1.5 m Triaxial Cable
41501A/B HPSMU	Input (Force/Sense)	3 m or 1.5 m Kelvin Triaxial Cable

3. Connect the 16441A output terminals to the 16442A input terminals, or to the connector plate input terminals, using 40 cm triaxial cables as shown below:

16441A Output	16442A Input or Connector Plate Input		
Output Force ^a	SMU1, 2, 3, 4, 5, or 6		
Output Force ^b	SMU1	SMU3	SMU5
Output Sense ^b	SMU2	SMU4	SMU6

a. For non-Kelvin connection.

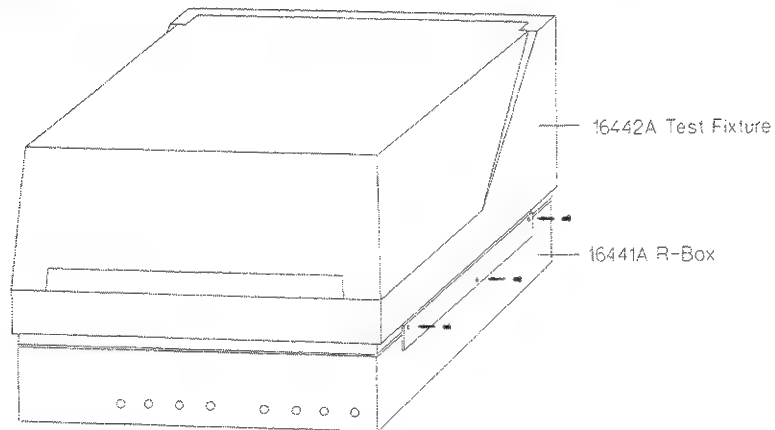
b. For the Kelvin connection, two triaxial cables must be used to connect the 16441A and the 16442A, instead of a Kelvin triaxial cable.

Installing the 16441A R-box with other accessories

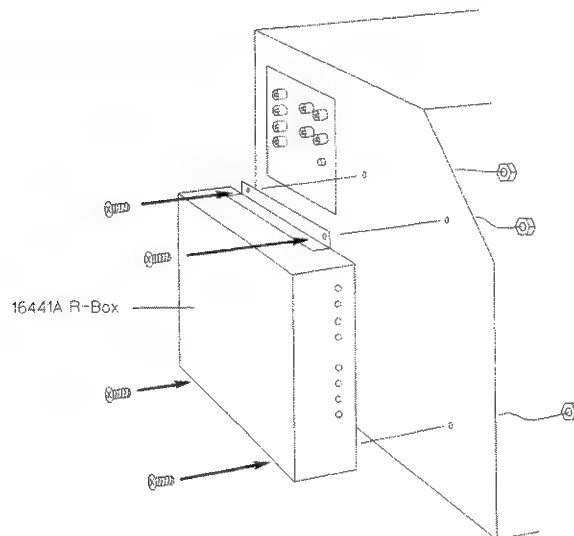
You can attach the 16441A R-box to the 16442A test fixture or to your shielding box, as shown in the following figures.

Installation
Installing Accessories

Attaching the 16441A R-Box to the 16442A Test Fixture



Attaching the 16441A R-Box to the Shielding Box

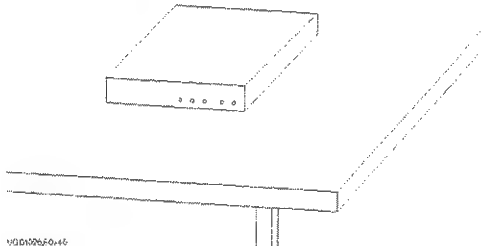
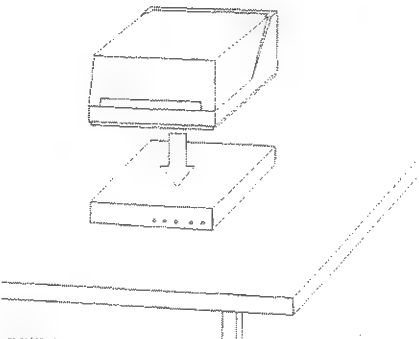
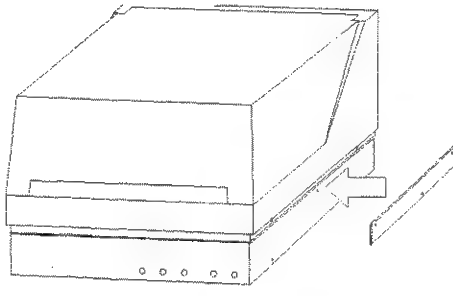
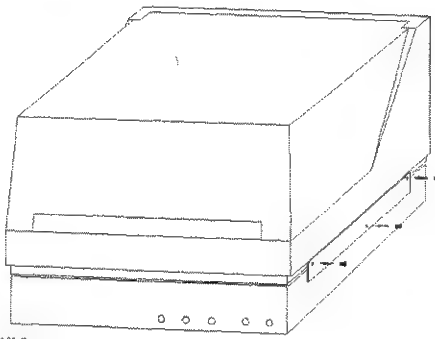


Installation
Installing Accessories

To Install the 16440A SMU/Pulse Generator Selector

To use the 16440A, the 4155B/4156B must be equipped with an 41501A/B SMU/pulse generator expander with two PGUs.

- To attach the 16440A selector to the 16442A test fixture:

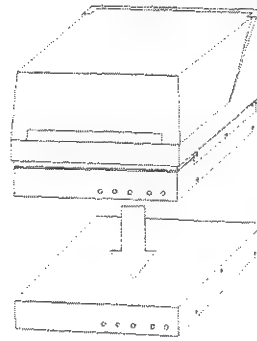
1. Place the 16440A selector on your workbench.	2. Place the 16442A test fixture on top of the 16440A selector.
 <p>UGDA026FO-46</p>	 <p>UGAD0440A-47</p>
3. Position a plate on both sides.	4. Attach each plate using the three flathead screws supplied with the instrument.
 <p>UGAD0440A-48</p>	 <p>UGD102460A-49</p>

Installation

Installing Accessories

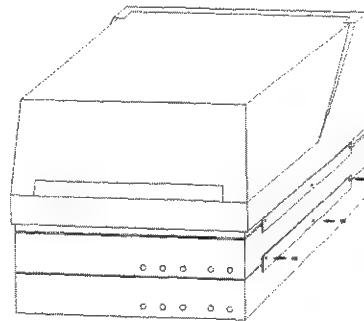
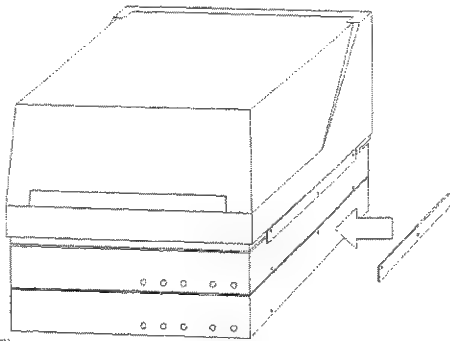
- The following steps apply when using two 16440A SMU/pulse generator selectors:

5. Place the second 16440A on your workbench. Place the 16440A selector and the 16442A test fixture on top of the second 16440A.



6. Position a plate on both sides.

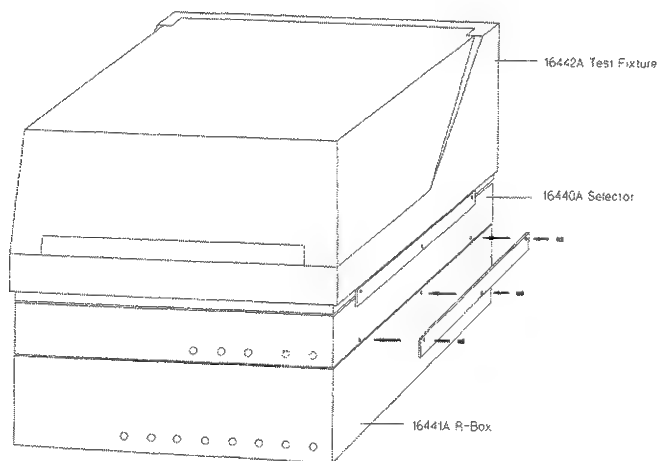
7. Attach each plate using the three flathead screws supplied with the instrument.



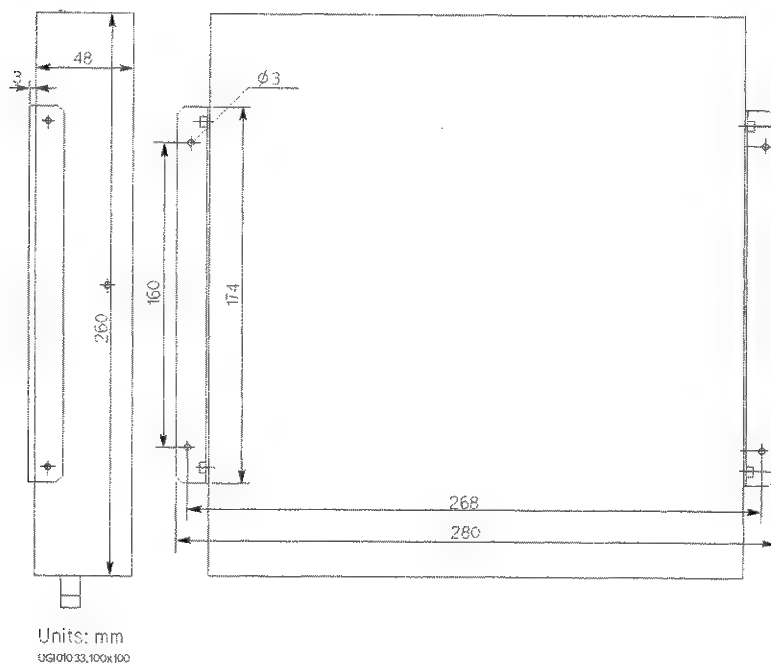
Installation

Installing Accessories

- To attach an 16441A R-box to the 16442A test fixture and the 16440A selector:



- To attach the 16440A selector to a shielding box:

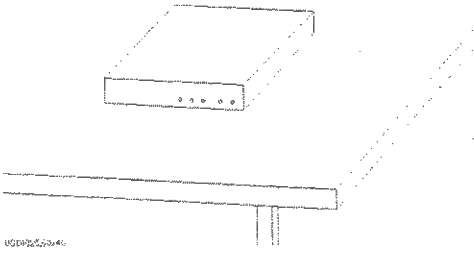
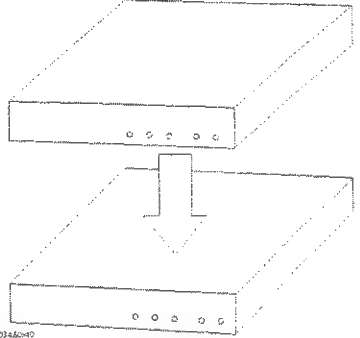
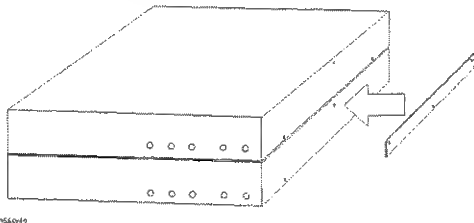
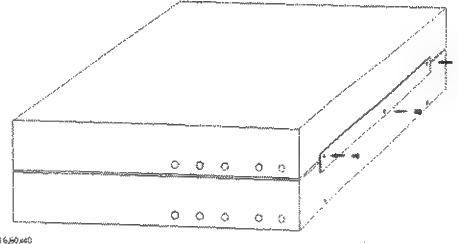


The figure above shows the spacing of the 16440A screw holes. You need to prepare four screws and nuts to match the screw holes.

Installation

Installing Accessories

- If you use two 16440As, connect the 16440As before connecting to the shielding box, as shown below:

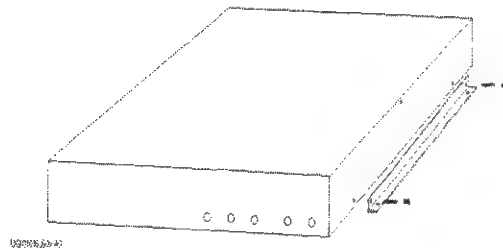
1. Place the 16440A on your workbench.	2. Place the second 16440A on top of the 16440A.
 <p>UG007550-40</p>	 <p>UG007550-40</p>
3. Position a plate on both sides.	4. Attach each plate using the three flathead screws supplied with the instrument.
 <p>UG007550-40</p>	 <p>UG007550-40</p>

Installation

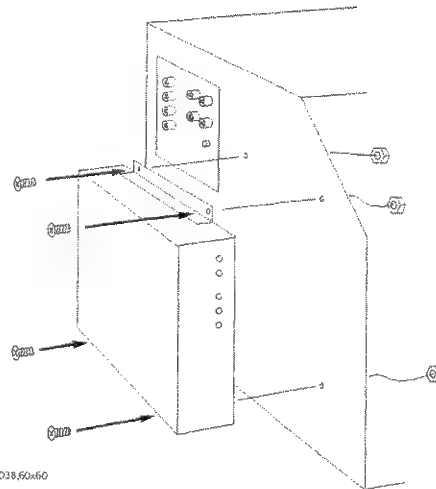
Installing Accessories

- To connect the selector to the shielding box:

1. Attach an angle bracket to each side of the 16440A, using the screws supplied.



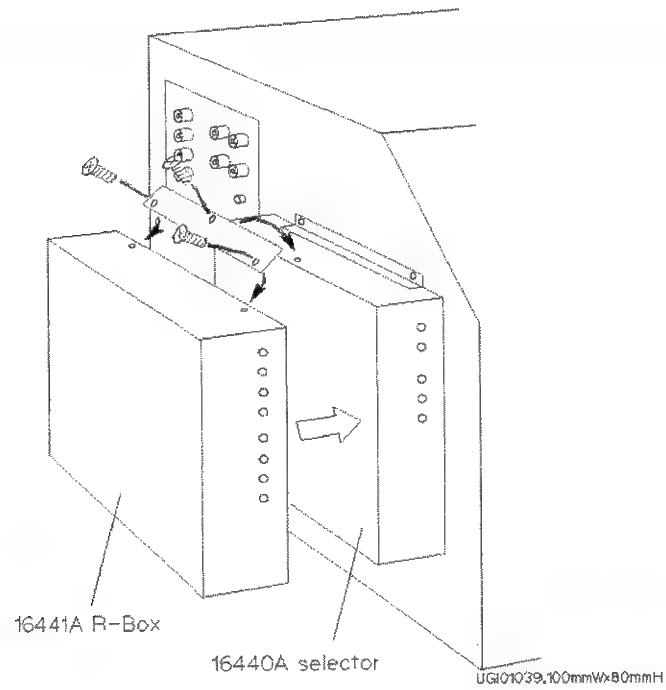
2. Place the 16440A(s) on the side panel of the shielding box.
3. Position four nuts on the inside panel of the shielding box.
4. Attach the angle bracket to the shielding box using four flathead screws.



Installation

Installing Accessories

- To attach an 16441A R-box to the 16440A selector on the shielding box:

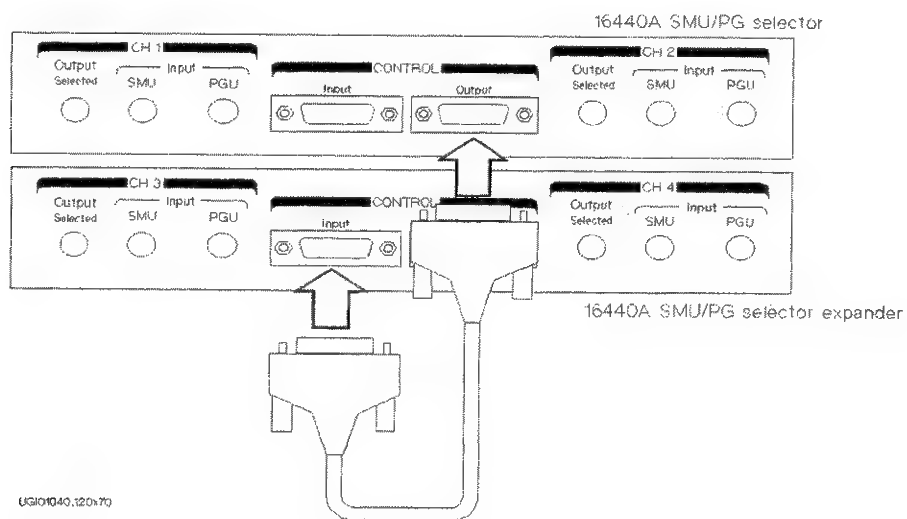


Installation
Installing Accessories

To Connect the 16440A Selector to the 4155B/4156B

- Connecting two 16440A selectors

If you use two 16440A, connect the Control Output terminal of the selector to the Control Input terminal of the second selector using a 40 cm control cable as shown below.

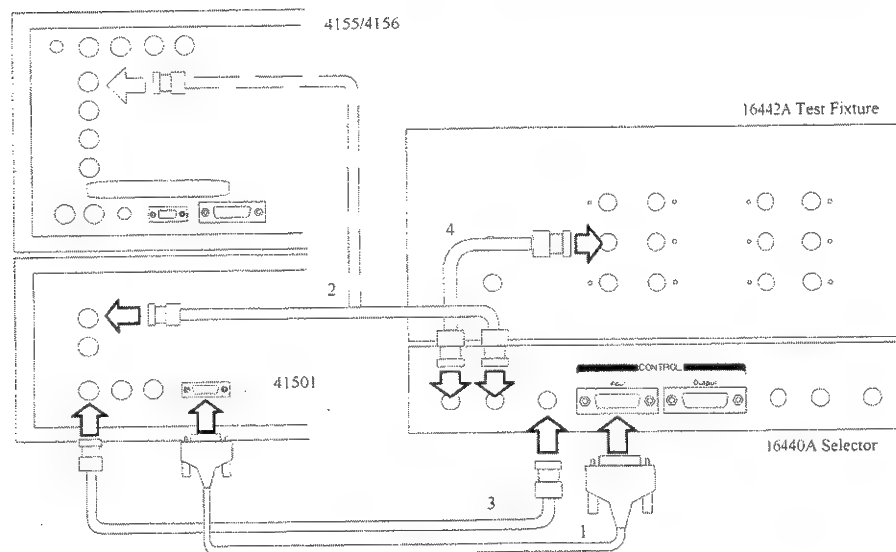


Installation

Installing Accessories

- Connecting the 16440A selector to the 4155B/4156B

Turn off the 4155B/4156B and 41501A/B before connecting the instruments. Then connect as shown below.



Instrument	Terminal	16440A Terminal	Cable
41501A/B	To SMU/Pulse Generator Selector Interface	CONTROL Input	3.0 m or 1.5 m Control Cable
	PGU	Input PGU ^a	3.0 m or 1.5 m Coaxial Cable
	MPSMU or HPSMU	Input SMU	3.0 m or 1.5 m Triaxial Cable
4155B	MPSMU	Output Selected ^b	40 cm Triaxial Cable
4156B	HPSMU		
16442A	SMU		
Connector Plate	SMU		

- You can use two inputs for one selector, and four inputs for two selectors.
- You can use two outputs for one selector and four outputs for two selectors. Selector output is either one of the PGU outputs or the SMU output.

Installation
Installing Accessories

To Connect the Measurement Cable to the Connector Plate

This section provides instructions for connecting the measurement cables from the 4155B/4156B to the connector plate. For connector plate installation information, refer to the *16495 Installation Guide*.

The following connector plates are available for the 4155B/4156B:

Agilent 16495H Connector Plate with 6 Triaxial Connectors

Option 001 has 6 triaxial through connectors (female to female), 6 BNC through connectors (female to female), an Intlk connector, and a GNDU connector (triaxial through, female to female). The back of the Intlk connector is designed for soldering.

Option 002 has 6 triaxial connectors, 6 BNC connectors, an Intlk connector, and a GNDU connector. The back of each connector is designed for soldering.

Agilent 16495J Connector Plate with 8 Triaxial Connectors

Option 001 has 8 triaxial through connectors (female to female), 4 BNC through connectors (female to female), an Intlk connector, and a GNDU connector (triaxial through, female to female). The back of the Intlk connector is designed for soldering.

Option 002 has 8 triaxial connectors, 4 BNC connectors, an Intlk connector, and a GNDU connector. The back of each connector is designed for soldering.

Connecting the measurement cables

Connect the measurement cables as shown below.

Instrument		Connector Plate		Cable
Model No.	Connector	Model No.	Connector	
4155B	Intlk	16495H/J	Intlk	16493J Interlock Cable
	MPSMU	16495H	INPUT 1 to 6	Triaxial Cable
		16495J	INPUT 1 to 8	
	VSU	16495H	INPUT 7 to 12	BNC cable
		16495J	INPUT 9 to 12	
	VMU	16495H	INPUT 7 to 12	BNC cable
		16495J	INPUT 9 to 12	
4156B	Intlk	16495H/J	Intlk	16493J Interlock Cable
	HRSMU	16495H	INPUT 1 to 6	Triaxial Cable or Kelvin Triaxial Cable
		16495J	INPUT 1 to 8	
	VSU	16495H	INPUT 7 to 12	BNC cable
		16495J	INPUT 9 to 12	
	VMU	16495H	INPUT 7 to 12	BNC cable
		16495J	INPUT 9 to 12	
41501A/B	GNDU	16495H/J	GNDU	16493H GNDU Cable
	HPSMU	16495H	INPUT 1 to 6	Triaxial Cable or Kelvin Triaxial Cable
		16495J	INPUT 1 to 8	
	MPSMU	16495H	INPUT 1 to 6	Triaxial Cable
		16495J	INPUT 1 to 8	
	PGU	16495H	INPUT 7 to 12	BNC cable
		16495J	INPUT 9 to 12	

Installation
Installing Accessories



Connecting the interlock terminal

The 4155B/4156B provides an interlock terminal to prevent you from receiving an electrical shock from high voltage (more than ± 40 V). If the interlock terminal is open, the 4155B/4156B *cannot* force high voltage more than ± 40 V.

When using the 16495H/16495J connector plate or the 16442A test fixture, connect the 4155B/4156B Intlk connector to the external interlock connector using the supplied 16493J interlock cable.

If you use your own connector plate or test fixture, make an interlock circuit as shown in "To Make an Interlock Circuit" on page 2-33. Then connect the 4155B/4156B Intlk connector to the external interlock connector by using the supplied 16493J interlock cable.

If you use a connector plate or test fixture that has a BNC coaxial connector as the interlock connector, connect the BNC interlock connector to the 4155B/4156B interlock terminal as follows:

- Required Parts:

Model No.	Quantity	Description
Agilent 16435A	1	Interlock Cable Adapter
Agilent 16493J	1	Interlock Cable (supplied with the 4155B/4156B)

- Procedure:

1. Connect the interlock (Intlk) connector on the 4155B/4156B rear panel to the interlock cable adapter using the supplied interlock cable.
2. Connect the interlock cable adapter to the connector plate or test fixture using the supplied coaxial cable.

Mounting Connectors

Previous sections described how to install the available accessories, and the *16495 Installation Guide* provides the information on how to install connector plates on the shielding box. However, you may choose to mount connectors directly on your own connector plate or test fixture.

To do this, you will need to make connector holes and mount the connectors yourself. This section contains information on connector hole dimensions.

To mount connectors:

1. Select the appropriate parts for your application. See Table 2-1.
2. Make the holes and mount the connectors. See Table 2-2.

For Kelvin connections using the 4156B SMU, use Agilent 16494B Kelvin cable. A Kelvin cable requires a Kelvin triaxial connector, which has two connector holes and three screw holes.

3. Build the interlock circuit shown in “To Make an Interlock Circuit” on page 2-33.
4. Attach cables from the connectors to the DUT (device under test). Refer to “To Connect the GNDU Output”, “To Connect the SMU Output”, and “To Connect the VSU/VMU/PGU Outputs” later in this chapter.

Table 2-1 lists the parts required to mount connectors on your shielding box. The type and quantity of parts needed will depend on your application.

Table 2-1

Recommended Parts

Usage	Agilent Part No.	Description
Making an interlock circuit	1252-1419	Interlock Connector (6 pin, female)
	3101-0302 or 3101-3241	Switch
	1450-0641	LED ($V_F \cong 2.1 \text{ V}$ @ $I_F = 10 \text{ mA}$)
	8150-4690	Wire
Connecting GNDU to DUT	1250-2457	Triaxial Connector (female)
	8120-3674 or 8150-2639	Coaxial Cable or Wire
Connecting SMU to DUT	1250-2457	Triaxial Connector (female)
	8120-4461	Low Noise Coaxial Cable

Installation
Mounting Connectors

Usage	Agilent Part No.	Description
Connecting VSU/VMU to DUT	1250-0118	BNC Connector (female)
	8150-0447	Wire
Connecting PGU to DUT	1250-0118	BNC Connector (female)
	8120-0102 or 8120-4461	Low Noise Coaxial Cable

Table 2-2 Dimensions of Connector Holes

Kelvin Triaxial Connector (in mm)	Triaxial Connector (in mm)
<p>Technical drawing of a Kelvin Triaxial Connector. It shows a rectangular base with four circular holes. The dimensions are: 1.4, 1.1, 1.1, 1.4 (horizontal spacing between holes), 10.3 (vertical distance from top edge to center of first hole), 11.3 (diameter of first hole), 3.2 (diameter of second hole), 2-M3x0.5 (thread specification for the second hole), and 2.8 (vertical distance from bottom edge to center of second hole).</p>	<p>Technical drawing of a Triaxial Connector. It shows a circular hole with a diameter of 11.3 and a vertical distance of 10.3 from the top edge to the center of the hole.</p>
BNC Connector (in mm)	Interlock Connector (in mm)
<p>Technical drawing of a BNC Connector. It shows a circular hole with a diameter of 12.8 and a vertical distance of 12.1 from the top edge to the center of the hole.</p>	<p>Technical drawing of an Interlock Connector. It shows a circular hole with a diameter of 6.2. The vertical distance from the top edge to the center of the hole is 5.1. The horizontal distance from the center of the hole to the right edge is 1.8.</p>

To Make an Interlock Circuit

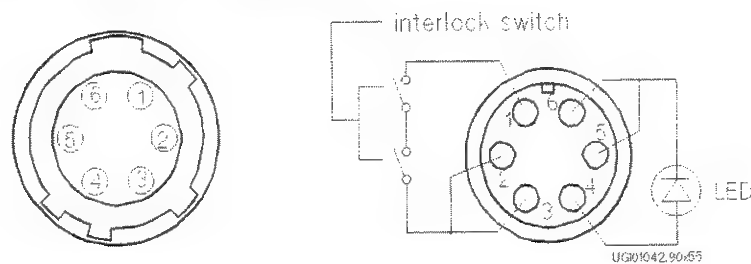
The interlock circuit is designed to prevent electrical shock when a user touches the measurement terminals.

CAUTION

You must install an interlock circuit on a shielding box to prevent hazardous voltages when the door of the shielding box is open.

Figure 2-1 shows the pin assignments of the interlock connector mounted on a connector plate or test fixture.

Figure 2-1 Interlock Connector Pin Assignments



(a) plug side view of Intlk terminal (b) wiring side view of Intlk terminal

WARNING

Potentially hazardous voltages may be present at the Force, Guard, and Sense terminals when the interlock terminals are shorted.

Installation

Mounting Connectors

Installing the interlock circuit

Install the interlock circuit as follows:

1. Mount two mechanical switches on your shielding box, so that the switches close when the door of the shielding box is closed, and open when the door is opened. For the dimensions of the switch, see Figure 2-2 and Figure 2-3 below.
2. Mount an LED on your shielding box. For the dimensions of the LED, see Figure 2-4.
3. Use wire to connect the two switches in series between pin number 1 and 2 (or 3) of the interlock connector. See Figure 2-1.
4. Use wire to connect the LED between pin number 4 and 5 (or 6) of the interlock connector. See Figure 2-1.

If the 4155B/4156B Intlk connector is connected to the interlock circuit, the 4155B/4156B SMU *cannot* force more than ± 40 V when the door is open. When the door is closed, it can force more than ± 40 V.

When more than ± 40 V is forced from an SMU, the LED lights to indicate *high voltage output*.

Figure 2-2

Dimensions of the Interlock Switch (Agilent part number 3101-0302)

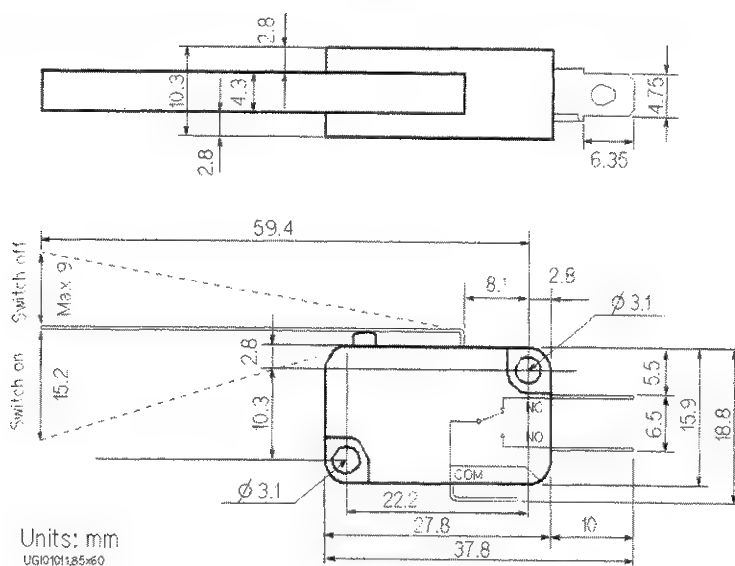


Figure 2-3

Dimensions of the Interlock Switch (Agilent part number 3101-3241)

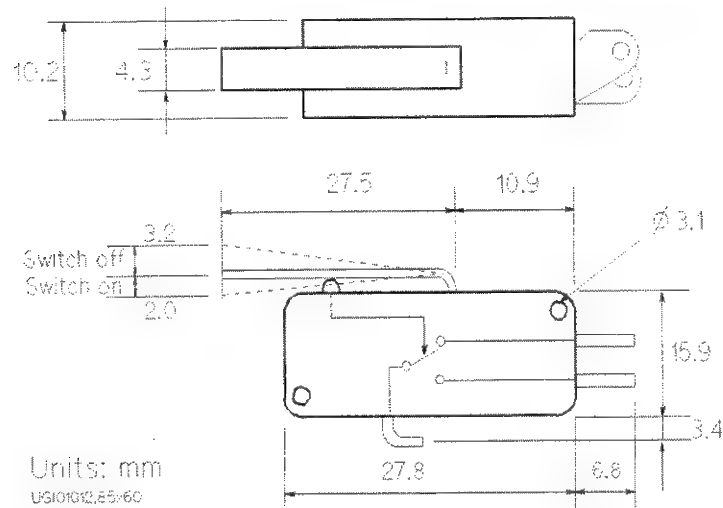
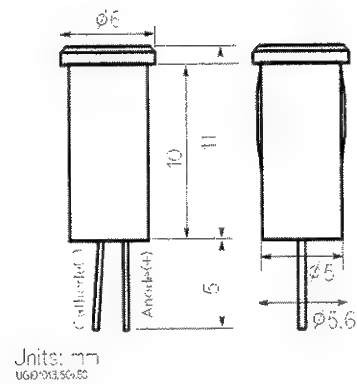


Figure 2-4

Dimensions of the LED (Agilent part number 1450-0641)



Installation
Mounting Connectors

NOTE

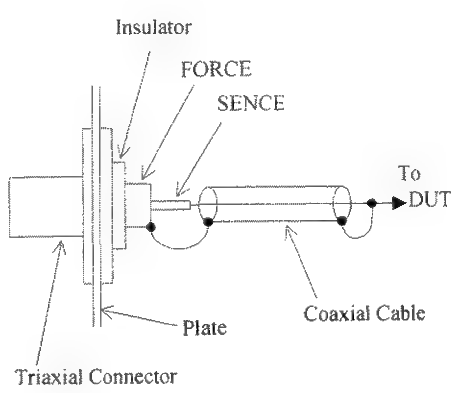
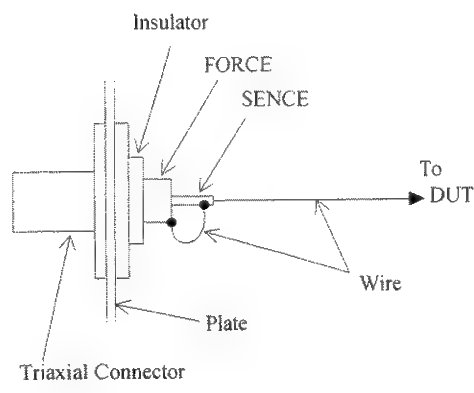
To Perform an Interlock Circuit Test

To confirm that the interlock circuit is operating properly, perform the following test.

1. Connect the Intlk terminal of the 4155B/4156B to your interlock circuit.
 2. Press System key, then select CALIB/DIAG softkey to display the SYSTEM: SELF-CALIBRATION/DIAGNOSTICS screen.
 3. In the CALIB/DIAG field, select DIAG softkey.
 4. In the CATEGORY field, select I/O PERIPH softkey.
 5. Move the pointer to 403 (INT.) Interlock LED.
 6. Select EXECUTE softkey.
 7. Confirm the following:
 - the LED turns on within 1 second when the interlock circuit is shorted.
 - the LED turns off within 1 second when the interlock circuit is opened.
 8. To stop the interlock test, select STOP softkey.
-

To Connect the GNDU Output

The following figures show connection examples for the GNDU output.

Kelvin connections	non-Kelvin connections
<p>Use a low-noise coaxial cable (Agilent part number 8120-3674) from the connector to the prober, socket, or DUT as shown. To cancel the effects of cable resistance, connect the Sense line and Force line as close as possible to the terminal of the DUT.</p>	<p>Short the Sense and Force on the connector as shown below. Use AWG 22 single-strand insulated wire (Agilent part number 8150-2639) from the connector plate to the prober, socket, or DUT. Measurement results include the residual resistance of the connection wire. For a quick connection where measurement accuracy is not critical, connect only Force to the DUT, without shorting the Sense and Force.</p>
	

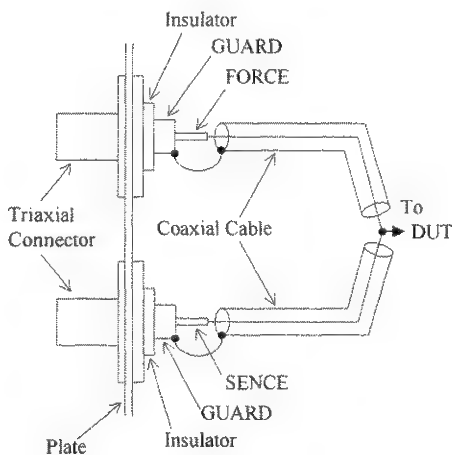
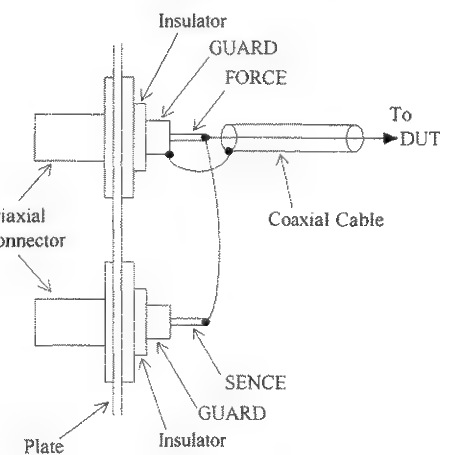
CAUTION

Use Agilent 16493H GNDU cable to connect the GNDU to your connector plate or test fixture. Do *not* use the triaxial cable. The GNDU is rated for up to 1.6 A, while the maximum current rating of the triaxial cable is 1 A.

Installation
Mounting Connectors

To Connect the SMU Output

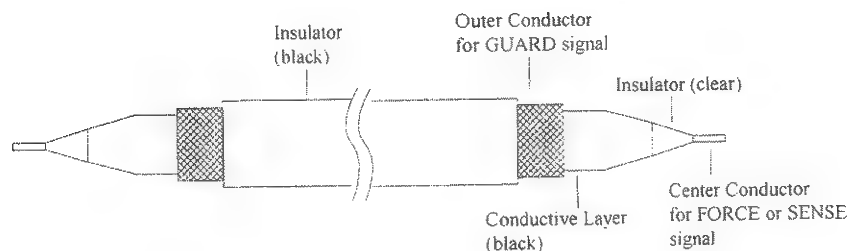
The following figures show connection examples for the SMU output.

Kelvin connections	non-Kelvin connections
<p>This connection is for the 4156B HRSMU or the 41501A/B HPSPMU. Use low-noise coaxial cable (Agilent part number 8120-4461) from the connector to the prober, socket, or DUT as shown. To cancel the effects of cable resistance, connect the Sense line and Force line as close as possible to the DUT terminal. To prevent oscillations, do not use cables longer than 1.5 m. To make accurate measurements when applying high currents, extend the guard as far as possible from the front panel connector to the DUT. Physically stabilize the cables with tape.</p>	<p>The following figure is for the HRSMU/HPSPMU connection using Kelvin triaxial cable. For the MPSMU connection, and for the HRSMU/HPSPMU connection using triaxial cable, connect the cable to the Force terminal only. Use low-noise coaxial cable (Agilent part number 8120-4461). To make accurate measurements when applying high currents, extend the guard as far as possible from the front panel connector to the DUT. Measurement results include residual resistance from the connection cable.</p>
 <p>The diagram shows a cross-section of a probe tip assembly. A triaxial connector is on the left, with three wires extending from it. The top wire is labeled 'GUARD' and is connected to a 'Plate' on the left. The middle wire is labeled 'FORCE' and is connected to a 'Coaxial Cable' that leads to the 'To DUT' terminal. The bottom wire is labeled 'SENCE' and is connected to a 'Coaxial Cable' that leads to the 'To DUT' terminal. An 'Insulator' is shown between the probe tip and the 'Plate'.</p>	 <p>The diagram shows a cross-section of a probe tip assembly. A triaxial connector is on the left, with three wires extending from it. The top wire is labeled 'GUARD' and is connected to a 'Plate' on the left. The middle wire is labeled 'FORCE' and is connected to a 'Coaxial Cable' that leads to the 'To DUT' terminal. The bottom wire is labeled 'SENCE' and is connected to a 'Coaxial Cable' that leads to the 'To DUT' terminal. An 'Insulator' is shown between the probe tip and the 'Plate'.</p>

NOTE

Low-Noise Coaxial Cable

When you make an SMU output connection by using low-noise coaxial cable (Agilent part number 8120-4461), trim the conductive layer and the insulator (clear) so that the center conductor is insulated from the conductive layer. Refer to the following figure.



CAUTION

Never connect the Guard terminal to any output, including circuit common, chassis ground, or any other guard terminal. Doing so will damage the SMU.

WARNING

Potentially hazardous voltages, up to ± 100 V (± 200 V for HPSMU), are present at the Force, Sense, and Guard terminals.

To prevent electrical shock, do not expose these lines.

Before turning the 4155B/4156B on, connect the Intlk terminal to a switch that turns off when the shielding box access door is opened.

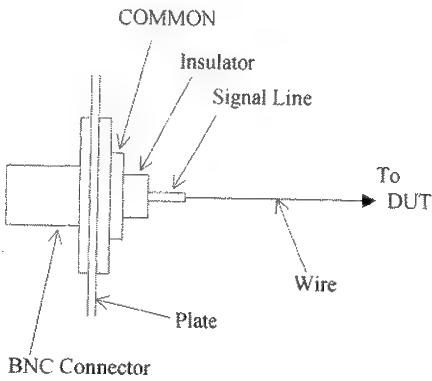
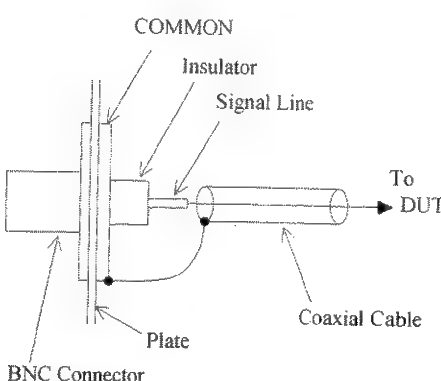
Before you touch any connections to these terminals, turn the 4155B/4156B off, disconnect the power cable, and discharge any capacitors.

Installation

Mounting Connectors

To Connect the VSU/VMU/PGU Outputs

The following figures show connection examples for VSU/VMU and PGU output.

VSU/VMU connector	PGU connector
Use AWG 24 single-strand insulated wire (Agilent part number 8150-0447) to connect to a probe, socket, or DUT.	Regardless of the output impedance setting, use a low-noise coaxial cable (Agilent part number 8120-0102) from the connector to a probe, socket, or DUT. If you use an 16440A selector, use a low-noise coaxial cable (Agilent part number 8120-4461).
 <p>The diagram shows a BNC Connector connected to a COMMON terminal. An Insulator is placed between the COMMON terminal and the Signal Line. A Wire is connected to the Signal Line and leads to the DUT. A Plate is shown at the bottom of the connector assembly.</p>	 <p>The diagram shows a BNC Connector connected to a COMMON terminal. An Insulator is placed between the COMMON terminal and the Signal Line. A Coaxial Cable is connected to the Signal Line and leads to the DUT. A Plate is shown at the bottom of the connector assembly.</p>

Connecting Instruments or Peripherals

The 4155B/4156B provides an GPIB interface, parallel I/O interface, and LAN interface for connection with other instruments or peripherals. This section contains information required to connect instruments or peripherals.

To Connect GPIB Instruments or Peripherals

The 4155B/4156B has an GPIB interface for instrument, printer, or plotter control.

- If you use an external controller with the 4155B/4156B, connect an GPIB cable between the controller and the 4155B/4156B.
- If you control instruments using the 4155B/4156B built-in IBASIC capability, connect an GPIB cable between the instrument and the 4155B/4156B.
- If you use an GPIB printer or plotter to make hard copies, connect an GPIB cable between the printer or plotter and the 4155B/4156B.

To use the GPIB interface, you will need to fill in the following entry fields on the SYSTEM: MISCELLANEOUS screen. For details of this setup screen, see "SYSTEM: MISCELLANEOUS screen" in Chapter 5.

Entry Field Name	Description
4155B is (4156B is)	Selects SYSTEM CONTROLLER or NOT SYSTEM CONTROLLER. Select NOT SYSTEM CONTROLLER if the 4155B/4156B will be used with an external controller. Select SYSTEM CONTROLLER if the 4155B/4156B will be used to control other instruments or peripherals.
GPIB ADDRESS	Sets the GPIB addresses of the 4155B/4156B and peripheral (printer or plotter). Enter the GPIB address in the 4155B or the 4156B field. Enter the GPIB address of the printer or plotter in the HARD COPY field.

Installation

Connecting Instruments or Peripherals

REMOTE

CONTROL

Selects the 4155B/4156B Control Command Set used to control the unit with an external controller or built-in IBASIC.

Select "4155/4156" to use the 4155B/4156B command set (SCPI or FLEX commands).

Select "4145" to use the 4145 syntax command set. You will also need to set the DELIMITER and EOI fields.

To Connect Parallel Peripherals

The 4155B/4156B has a 25 pin parallel I/O interface port for connecting peripherals, such as a Centronics parallel printer.

To use a parallel printer, connect a parallel cable from the 4155B/4156B to the peripheral. You do *not* need to define any fields on the setup screen.

To make hard copies, refer to Chapter 4.

To Connect to a LAN

The 4155B/4156B has a LAN connector (Ethernet IEEE 802.3 10BASE-T, RJ45 connector) on the rear panel, and can be connected to your LAN which satisfies the specifications for Ethernet IEEE 802.3 10BASE-T for a 10M bps CSMA/CD local area network.

Connecting the 4155B/4156B to your LAN allows you to do the following:

- Use the 4155B/4156B as a NFS client.

The 4155B/4156B can mount a directory on your NFS server. You can then store and retrieve 4155B/4156B data files using this directory.

- Use a remote printer.

The 4155B/4156B can output to a remote printer via your printer server. You can print the 4155B/4156B setup screen, measurement results, and screen images on the printer.

NOTE

Executing LAN Interface Test

If you want to check the LAN interface installed in the 4155B/4156B, do following:

1. Turn the 4155B/4156B on.
2. Attach the LAN I/F test adapter (Agilent part number 04155-61631, furnished with the 4155B/4156B) to the LAN connector on the rear panel.
3. Press System key, then select CALIB/DIAG softkey to display the SYSTEM: SELF-CALIBRATION/DIAGNOSTICS screen.
4. In the CALIB/DIAG field, select DIAG softkey.
5. In the CATEGORY field, select CPU softkey.
6. Move the pointer to 312 (INT.) LAN Interface using the down-arrow key.
7. Select EXECUTE softkey to execute the LAN interface test.

If the 4155B/4156B fails the test, contact to the nearest Agilent Technologies service office.

Installation

Connecting Instruments or Peripherals

Connecting to the LAN

To connect the 4155B/4156B to your LAN:

1. Register the 4155B/4156B on your local area network. Include the host name and IP address assigned for the 4155B/4156B.

NOTE

Network Setup Parameters

If you are uncertain as to your local network configuration, or have questions concerning the network setup parameters, contact your network system administrator.

The parameters should be registered and administered by the network system administrator.

2. Connect the LAN cable to the 4155B/4156B.
3. Turn the 4155B/4156B on.
4. Press System key, then select MISCELLANEOUS softkey to display the SYSTEM: MISCELLANEOUS screen.
5. Complete the 4155B (4156B) NETWORK SETUP table by entering the following parameters:

Entry Field	Description
HOST NAME	Host name of the 4155B/4156B
IP ADDRESS	IP address of the 4155B/4156B
USER ID	Your user ID
GROUP ID	Your group ID

Using the 4155B/4156B as an NFS client

To use the 4155B/4156B as an NFS client:

1. Enable NFS service on your NFS server.
2. Export a directory on the NFS server to be mounted by the 4155B/4156B.
3. Press System key, then select MISCELLANEOUS softkey to display the SYSTEM: MISCELLANEOUS screen.
4. Complete the NETWORK DRIVE SETUP table by entering the following parameters:

Entry Field	Description
LABEL	Label or name for the setup information on the NETWORK DRIVE SETUP table.
IP ADDRESS	IP address of NFS server.
DIRECTORY	Name of the directory to be mounted by the 4155B/4156B.

5. Select ADD softkey to register the setup in the internal memory.
6. To mount the directory and to perform file operations, refer to Chapter 3.

Installation

Connecting Instruments or Peripherals

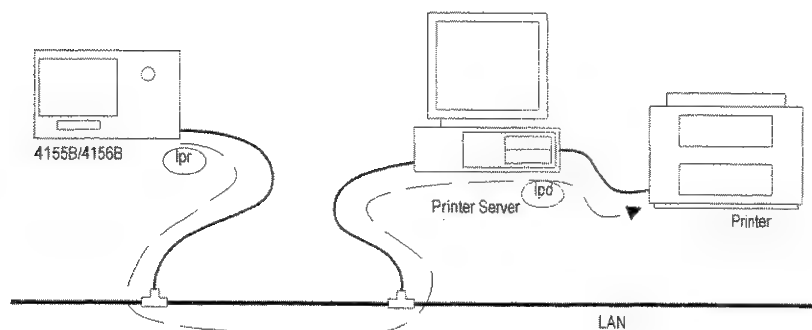
Using a remote printer

To use a remote printer:

1. Connect a printer to your printer server, and set your printer server to use the printer as an remote printer. Then lpd/lpr must be enabled on the printer server.
2. Press System key, then select MISCELLANEOUS softkey to display the SYSTEM: MISCELLANEOUS screen.
3. Complete the NETWORK PRINTER SETUP table by entering the following parameters:

Entry Field	Description
PRINTER	Printer name assigned to the printer, and defined on the printer server.
IP ADDRESS	IP address of the printer server.
TEXT OUT	Text output option of lpr command.
GRAPH OUT	Graphics output option of lpr command.
SERVER TYPE	Server type (BSD or SystemV).

4. Select ADD softkey to register the setup in the internal memory.
5. To make hard copies using the remote printer, refer to Chapter 4.



File Operations

This chapter covers the following file operations:

- selecting a mass storage device
- listing a file catalog
- storing setup or results data
- storing data in spreadsheet format
- loading setup or results data
- changing a file name
- removing a file/directory
- copying a file
- creating a directory on a network file system
- changing the working directory
- initializing a diskette
- backing up a diskette

You can use these file operations on the internal memory, a diskette in the built-in flexible disk drive, or on a network file system that Agilent 4155B/4156B mounts.

You can perform file operations by:

- selecting softkeys on the SYSTEM: FILER screen. (All file operations can be performed this way.)
- selecting the front-panel keys Get and Save from the User File key group. (Only store and load file operations can be performed this way.)

For details on the SYSTEM: FILER screen, refer to the “SYSTEM: FILER screen” in Chapter 5.

NOTE**To Use the Network File System**

The 4155B/4156B can be an NFS client, and can use the network file system as a mass storage device.

To use the network file system:

1. Connect the 4155B/4156B to your LAN. See "To Connect to a LAN" in Chapter 2.
2. Complete the NETWORK SETUP table on the SYSTEM: MISCELLANEOUS screen.
3. Complete the NETWORK DRIVE SETUP table on the SYSTEM: MISCELLANEOUS screen.

For information on the SYSTEM: MISCELLANEOUS screen, see "SYSTEM: MISCELLANEOUS screen" in Chapter 5.

NOTE**Situations When You Cannot Store/Load Files**

The Save and Get keys are available from any screen. However, the Save and Get functions will not work under the following conditions:

- during measurement or forcing stress
- when an error message is displayed
- when the HELP screen is displayed
- when the KNOB SWEEP screen is displayed
- when the SCREEN DUMP, PRINT/PLOT, or GRAPH PLOT dialog is displayed

Selecting a Mass Storage Device

To start a file operation, you must specify the mass storage device by selecting either the built-in flexible disk drive or a network file system.

1. Press System key.
2. Select FILER softkey to display the SYSTEM: FILER screen.
3. Move the cursor to the DISK entry field.
4. Select one of the following secondary softkeys.

FLOPPY Specifies the diskette in the built-in flexible disk drive.

Insert a diskette into the built-in flexible disk drive.

drive name If you have set up a drive label in the NETWORK DRIVE SETUP table, this label will appear as a softkey. Up to four softkeys can be added this way.

Before selecting one of these directories, it must be exported so that it can be mounted by the 4155B/4156B.

When this softkey is pressed, the 4155B/4156B mounts the directory on an NFS server, and displays the file catalog in the FILE CATALOG area. The directory name will be shown next to the DISK entry field, and it will be the root directory.

To unmount the directory, choose another secondary softkey or turn off the 4155B/4156B.

Listing a File Catalog

1. Press System key.
2. Select FILER softkey to display the SYSTEM: FILER screen.
3. Specify the mass storage device.
4. Select FILE CATALOG softkey. A maximum of 199 file names can be displayed in the FILE CATALOG area.
5. Use the rotary knob to move the cursor or to scroll through the list of file names.

For details on the FILE CATALOG area, refer to "SYSTEM: FILER screen" in Chapter 5.

To Display File Comments (only for diskette)

If the built-in flexible disk drive is specified as the mass storage device, the FILE CATALOG area will not include the file comments. To display the file comments, select one of the following softkeys:

READ

COMMENT Reads and displays the comments for the selected file.

READ

COMMENT ALL Reads and displays the comments for all files.

To Exit the File Catalog

Select EXIT FILE CATALOG softkey.

To Search for a Desired File Name

Enter an alphanumeric character. The cursor will move to the first file name that starts with that character.

File Operations

Storing Setup or Results Data

Storing Setup or Results Data

1. To store data to a file in the current mass storage device, press Save key to display the SAVE setup fields.
2. To change the mass storage device:
 - a. Press System key.
 - b. Select FILER softkey to display the SYSTEM: FILER screen.
 - c. Specify the new mass storage device.
 - d. Select SAVE softkey to display the SAVE setup fields.

FUNCTION: SAVE			
NAME	<input type="text"/>		
	TYPE	<input type="text"/>	COMMENT
		<input type="text"/>	<input type="text"/>

3. In the NAME field, do one of the following:
 - To store the data in a new file on a diskette, enter a file name that is a maximum of 8 characters (for DOS format) or a maximum of 6 characters (for HP LIF format). For HP LIF format, do *not* use "_" as the last character of the filename.
 - To store data in a new file on the network file system, enter a file name, 36 characters maximum. The file name and directory path combined can be 58 characters maximum.
 - To store data in an existing file, select FILE CATALOG softkey. Use the rotary knob to move the cursor to the correct file, then press SELECT softkey.
 - To store data in an internal memory, select MEM1, MEM2, MEM3 or MEM4 softkey.

File Operations
Storing Setup or Results Data

4. In the TYPE field, select:
 - MES softkey for measurement setup data.
 - STR softkey for stress setup data.
 - DAT softkey for measurement setup and results data.
 - CST softkey for customized system data. (This is not available when storing in internal memory.)
5. In the COMMENT field, you may enter a comment of up to 16 characters. (When using internal memory, the specified comment will be displayed on the softkey.)
6. Select EXECUTE softkey. The data will be stored in the specified file.
Any data previously stored in the existing file or internal memory will be overwritten.
7. Select EXIT softkey.

Storing Results Data in Spreadsheet Format

1. Specify the mass storage device.
2. Display the results data on the GRAPH/LIST: LIST screen.
To display the GRAPH/LIST: LIST screen, press Graph/List key. If the GRAPH/LIST: GRAPHICS screen is displayed, press Graph/List key again.
3. Select SPREAD SHEET softkey to display the ASCII SAVE setup fields.
For a list of files in the mass storage device, select FILE CATALOG softkey.

FUNCTION:ASCII SAVE			
NAME	<input type="text"/>		
UNIT	<input type="text"/>		
OUTPUT DATA (INDEX NO)	DELIMITER	<input type="text"/>	
<input type="text"/> <--> <input type="text"/>	STRING MARK	<input type="text"/>	

4. In the NAME field, enter the name of the file (with no file extension) in which you want to save data. The file name may be:
 - a maximum of 8 characters to store on a DOS diskette.
 - To store data in a new file on the network file system, enter a file name, 36 characters maximum. The file name and directory path combined can be 58 characters maximum.
5. In the OUTPUT DATA field, enter the range of results data you want to save (corresponds to NO. column on the LIST screen). The left field is the lower limit and the right field is the upper limit.
Select ALL softkey to specify all results data.
6. In the UNIT field, select one for the following:
 - ON softkey will save the unit of measure (such as V or ms) with the results data. If the UNIT is ON, results data will be treated as string data.
 - OFF softkey will *not* save the units of measure. Results data will be treated as numeric data.

With UNIT ON or OFF, invalid data (----) will be treated as string data.

7. In the DELIMITER field, select:
 - SPACE softkey to specify a space as the data delimiter.
 - TAB softkey to specify a tab as the data delimiter.
 - COMMA softkey to specify a comma as the data delimiter.
8. In the STRING MARK field, select:
 - NONE softkey to specify no string marker.
 - " " softkey to specify " " as the string marker.
 - \ ' softkey to specify \ ' as the string marker.
9. Select EXECUTE softkey. The results data will be saved to the specified file, and a .TXT extension is automatically added.
10. Select EXIT softkey.

File Operations

Storing Results Data in Spreadsheet Format

Output Format for the ASCII SAVE Function

The following is the output format for each item on the LIST screen. This notation is used to indicate the string or numeric type:

[S]	string
[S/N]	If the UNIT field is ON, the value is output as a string with a string marker. If the UNIT field is OFF, the value is output as a numeric value.
[N]	numeric value

1. user comment

User comment is output as a string with a specified string marker.

- Example (setups: STRING MARK = " ")

"Bipolar Tr. Vce-Ic"

2. VAR1 output range

For sweep measurements:

Format: <VAR1 name> = <start> to <stop> in <step> step

Type: [S] [S/N] [S] [S/N] [S] [S/N] [S]

For log sweep measurements, LOG is output for the step value.

- Example
(setups: UNIT=OFF, STRING MARK=" ", DELIMITER=COMMA)

"VCE=", 0.0001, "to", 1, "in", "LOG", "step"

For sampling measurements:

Format: @TIME = <start time> to <stop time>

Type: [S] [S/N] [S] [S/N]

- Example
(setups: UNIT=ON, STRING MARK=" ", DELIMITER=COMMA)

"@TIME=", "0.00 s", "to", "1.516 s"

File Operations
Storing Results Data in Spreadsheet Format

3. VAR2 output range

Format: <VAR2 name> = <start value>to<stop value>in<step value>step

Type: [S] [S/N] [S] [S/N] [S] [S/N] [S]

- Example
(setups: UNIT=OFF, STRING MARK= " ", DELIMITER=COMMA)
"IB=" , 1E-05, "to" , 5E-05, "in" , 1E-05, "step"

4. variable names

Format: NO. <variable name> <variable name>

Type: [S] [S] [S]

- Example (setups: STRING MARK= " ", DELIMITER=COMMA)
"NO." , "VCE" , "IC"

5. unit

Format: <blank><1st variable unit><2nd variable unit>

Type: [S] [S] [S]

- Example (setups: STRING MARK= " ", DELIMITER=COMMA)
" " , "V" , "A"

6. measurement data

Format: <index><1st variable data><2nd variable data>

Type: [N] [S/N] [S/N]

- Example (setups: UNIT=OFF, DELIMITER=COMMA)
1, 0.001, -9.265E-10, . . . , . . .

File Operations

Storing Results Data in Spreadsheet Format

Output Examples

1. Lotus 1-2-3 Output Example

- Setups
 - UNIT = OFF
 - DELIMITER = COMMA
 - STRING MARK = " "
- Output

```
"Bipolar Tr. Vce-Ic"
"VCE=",0.0001,"to",1,"in","LOG","step"
"IB=",1E-05,"to",5E-05,"in",1E-05,"step"
"NO.", "VCE", "IC"
"V", "V", "A"
1,0.0001,-9.265E-10
2,0.00013,1.0416E-09
3,0.00016,1.527E-09
4,0.0002,-8.975E-10
5,0.00025,-1.7453E-09
```

2. Microsoft Excel Output Example

- Setups
 - UNIT = OFF
 - DELIMITER = TAB
 - STRING MARK = NONE
- Output

```
V3-I3 characteristics
V3 = 0 to 1 in 0.1 step
I3 = 2E-05 to 0.0001 in 2E-05 step
NO.  V3    I3
      V    A
1     0    1.665E-09
2    0.1  1.9072E-09
3    0.2  1.4471E-08
4    0.3  1.8823E-07
5    0.4  2.1995E-06
```

File Operations Storing Results Data in Spreadsheet Format

3. Append Measurement Output Example

- Setups

- UNIT = OFF
- DELIMITER = TAB
- STRING MARK = NONE

- Output

```
V3 = 0 to 1 in 0.5 step <---Single
I2 = 2E-05 to 0.0001 in 2E-05 step <---Single
/* Append 1 */
V3 = 0 to 1 in 0.5 step <---Append1
I2 = 2E-05 to 0.0001 in 2E-05 step <---Append1
/* Append 2 */
V3 = 0 to 1 in 0.5 step <---Append2
I2 = 2E-05 to 0.0001 in 2E-05 step <---Append2
NO. V3 I3 -----Single
      V  A
1    0  4.3E-13
2    0.5 5.7E-13
3    1  3.1E-13
.
.
.
15   1  3.2E-13 -----+

/* Append 1 */
NO. V3 I3 -----Append1
      V  A
1    0  1.7E-13
2    0.5 8E-13
3    1  2.8E-13
.
.
.
15   1  4.5E-13 -----+

/* Append 2 */
NO. V3 I3 -----Append2
      V  A
1    0  1.5E-13
2    0.5 7E-13
3    1  2.5E-13
.
.
.
15   1  5E-13 -----+
```

File Operations

Loading Setup or Results Data

Loading Setup or Results Data

1. To load data from a file in the present mass storage device, press Get key.
2. To change the mass storage device, do the following:
 - a. Press System key.
 - b. Select FILER softkey to display the SYSTEM: FILER screen.
 - c. Specify the new mass storage device.
 - d. Select GET softkey.

FUNCTION: GET	
NAME	<input type="text"/>
TYPE	<input type="text"/>

3. In the NAME field, do one of following.
 - To load a file from a diskette or a network file system:
 - a. Select FILE CATALOG softkey.
 - b. Move the cursor to the desired file name using the rotary knob.
 - c. Press SELECT softkey. This sets the NAME and TYPE entries.
 - To load data from internal memory, select MEM1, MEM2, MEM3 or MEM4 softkey.
4. Select EXECUTE softkey.
5. Select EXIT softkey.

If the Setup File does not match the present configuration

If the information in the setup file is different than the current system unit configuration, the 4155B/4156B will change the setup values when loading the file.

- If the file has an HPSMU setup, but the current system does not have an HPSMU, two parameters will be changed:
 - Voltage Measurement Range: 200 V \Rightarrow 100 V
 - Current Measurement Range: 1 A \Rightarrow 100 mA
- If you try to load an 4156A/B setup on the 4155B, one parameter will be changed:
 - Current Measurement Range: 10 pA or 100 pA \Rightarrow 1 nA

Changing a File Name

1. Press System key.
2. Select FILER softkey to display the SYSTEM: FILER screen.
3. Specify the mass storage device.
4. Select RENAME softkey to display the RENAME setup fields.

FUNCTION: RENAME	
NAME	<input type="text"/>
TYPE	<input type="text"/>
NEW NAME	<input type="text"/>

5. Select FILE CATALOG softkey.
6. Move the pointer to the file name to be changed using the rotary knob.
7. Select SELECT SOURCE softkey. This sets the NAME and TYPE entries.
8. In the NEW NAME field, enter a new name. The name may be:
 - a maximum of 6 characters for a diskette in HP LIF format. Do *not* use " " as the last character of the filename.
 - a maximum of 8 characters for a diskette in DOS format.
 - To store data in a new file on the network file system, enter a file name, 36 characters maximum. The file name and directory path combined can be 58 characters maximum.

To change the file name to an existing file name:

Select FILE CATALOG softkey, and move the pointer to the desired file name using the rotary knob. Then press SELECT TARGET softkey.

9. Select EXECUTE softkey. The file name will be changed to the specified new name.
10. Select EXIT softkey.

Removing a File/Directory

1. Press System key.
2. Select FILER softkey to display the SYSTEM: FILER screen.
3. Specify the mass storage device.
4. Select PURGE softkey.

FUNCTION: PURGE	
NAME	<input type="text"/>
TYPE	<input type="text"/>

5. Select FILE CATALOG softkey.
6. Move the pointer to the file or directory to be removed using the rotary knob.
The directory to be removed must be empty.
7. Press SELECT softkey. This sets the NAME and TYPE entries.
8. Select EXECUTE softkey, then select one of the following:
 - YES softkey to remove the file/directory.
 - NO softkey to cancel.
9. Select EXIT softkey.

Removing multiple files

To remove multiple files with the same filename, but different file extensions, select * softkey in the TYPE field. When you execute, all file by that name will be deleted, regardless of their extension.

For example, if the NAME field is MOS1 and the TYPE field is *, then all the following files would be deleted:

```
MOS1.MES  
MOS1.STR  
MOS1.DAT  
MOS1.CST  
MOS1.PRO
```

Copying a File

1. Press System key.
2. Select FILER softkey to display the SYSTEM: FILER screen.
3. Specify the mass storage device.
4. Select COPY softkey to display the COPY setup fields.

FUNCTION: COPY	
SOURCE NAME	
TYPE	TARGET DISK
TARGET NAME	

5. In the SOURCE NAME field, do one of the following:
 - To copy from a diskette or a network file system:
 - a. Select FILE CATALOG softkey.
 - b. Move the pointer to the desired file name using the rotary knob.
 - c. Press SELECT SOURCE softkey. This sets the SOURCE NAME and TYPE entries.
 - To copy from internal memory, select MEM1, MEM2, MEM3 or MEM4 softkey.
6. To copy a file from one diskette to another diskette:
 - a. Move the pointer to the TARGET DISK field.
 - b. Select OTHER softkey. (SAME softkey will copy the file back onto the source diskette.)

File Operations
Copying a File

7. In the TARGET NAME field, do one of the following:
 - To copy a file to a new file, enter the new file name.
 - a maximum of 6 characters for an HP LIF diskette. Do not use "_" as the last character of the filename.
 - a maximum of 8 characters for a DOS diskette.
 - To store data in a new file on the network file system, enter a file name, 36 characters maximum. The file name and directory path combined can be 58 characters maximum.
 - To copy a file to an existing file:
 - a. Select FILE CATALOG softkey.
 - b. Move the pointer to the desired file name using the rotary knob.
 - c. Press SELECT TARGET softkey. This sets the TARGET NAME entry.
 - To copy a file to internal memory, select MEM1, MEM2, MEM3 or MEM4 softkey.
8. Select EXECUTE softkey.
9. If you are copying a file from one diskette to another, follow these on-screen instructions.

Insert Source Diskette.
Continue? (YES / NO)

YES Insert the source diskette in the disk drive, then select this softkey.

NO Suspends the copy operation.

Insert Target Diskette.
Continue? (YES / NO)

YES Insert the target diskette in the disk drive, then select this softkey.

NO Suspends the copy operation.
10. Select EXIT softkey.

File Operations

Creating a Directory on a Network File System

Creating a Directory on a Network File System

1. Press System key.
2. Select FILER softkey to display the SYSTEM: FILER screen.
3. Specify the mass storage device as a network file system.
4. Select MAKE DIRECTORY softkey.

FUNCTION:MAKE DIRECTORY	
NAME	<input type="text"/>

5. In the NAME field, enter the new directory name.
The directory name can be 36 characters maximum. The directory name and directory path combined can be 58 characters maximum.
6. Select EXECUTE softkey.
7. Select EXIT softkey.

Changing the Working Directory

1. Press System key.
2. Select FILER softkey to display the SYSTEM: FILER screen.
3. Specify the mass storage device as a network file system.
4. Select FILE CATALOG softkey.
5. To specify the working directory:
 - a. Move the pointer to the desired directory using the rotary knob.
 - b. Select CHANGE DIRECTORY softkey.
6. To change the working directory to the upper level, select one of the following:
UPPER DIR Moves to the directory one level higher than the current directory.
ROOT DIR Moves to the root directory.
7. Select EXIT FILE CATALOG softkey.

Initializing a Diskette

1. Press System key.
2. Select FILER softkey to display the SYSTEM: FILER screen.
3. Move the pointer to the DISK field.
4. Select FLOPPY softkey.
5. Select DISK OPERATION softkey to display the setup fields.
6. In the DISK OPERATION field, select DISK INIT softkey.
7. In the FORMAT field, select DOS softkey or HP LIF softkey.
8. (Optional) In the VOLUME NAME field, enter a volume name.
9. Select EXECUTE softkey.
10. After the confirmation message, insert a diskette in the flexible disk drive, then select:
 - YES softkey to initialize the diskette.
 - NO softkey to cancel.

The PROGRESS STATUS field shows what percentage of the initialization is completed.
11. Select EXIT softkey.

Backing Up a Diskette

1. Press System key.
2. Select FILER softkey to display the SYSTEM: FILER screen.
3. Move the pointer to the DISK field.
4. Select FLOPPY softkey.
5. Select DISK OPERATION softkey to display the setup fields.
6. In the DISK OPERATION field, select DISK COPY softkey.
7. Insert the source diskette, select EXECUTE softkey, then select one of the following:
 - YES softkey to execute the disk copy.
 - NO softkey to cancel the disk copy.
8. After the target diskette message is displayed, remove the source diskette and insert an initialized target diskette. The target and source diskettes must be the same format and size. Select:
 - YES softkey to execute the disk copy.
 - NO softkey to cancel the disk copy.

The PROGRESS STATUS field shows what percentage of the disk copy is complete.

The internal memory capacity may not be sufficient to perform the entire disk copy. If so, swap the source and target disks according to the on-screen instructions.
9. Select EXIT softkey.

File Operations
Backing Up a Diskette

Print/Plot Function

Agilent 4155B/4156B print/plot function enables you to print, plot, or save to a file the following types of data:

- Screen images from the 4155B/4156B display
- Lists of setup data from the setup screens (except for the GRAPH/LIST and KNOB SWEEP screens)
- Lists of measurement data from the GRAPH/LIST: LIST screen
- Graphs of measurement data from the GRAPH/LIST: GRAPHICS and KNOB SWEEP screens

This chapter explains how to use the print/plot function, and consists of the following sections:

- “Output Formats”
- “Supported Peripherals”
- “Printing/Plotting Screen Images”
- “Printing/Plotting Setup Data Lists”
- “Printing/Plotting Measurement Data Lists”
- “Printing/Plotting Measurement Data Graphs”
- “Saving Screen Images”
- “Saving Setup Data Lists”
- “Saving Measurement Data Lists”
- “Saving Measurement Data Graphs”
- “Output Examples”

Output Formats

The print/plot function supports PCL, HP-GL, and TIFF formats, and provides the following five output modes:

PCL	For making hard copies using a peripheral that supports PCL, or for saving the hard copy image to a PCL file.
HR PCL	High resolution PCL. For making hard copies using a peripheral that supports PCL, or for saving the hard copy image to a PCL file. Output quality is higher than the PCL mode.
HP-GL	For making hard copies using a peripheral that supports HP-GL, or for saving the hard copy image to an HP-GL file. Mainly used for a plotter.
TIFF	For saving screen images to a TIFF file.
HR TIFF	High resolution TIFF. For saving screen images or measurement graph hard copy images to a TIFF file. Output quality is higher than the TIFF mode.

The display screens and output format available for each print, plot, or save function are as follows:

	4155B/4156B Display Screens	Output Format
Printing/plotting screen images (screen dumps)	all	PCL, HR PCL or HP-GL
Printing/plotting setup data lists	all setup ¹	
Printing/plotting measurement data lists	GRAPH/LIST: LIST	
Printing/plotting measurement data graphs	GRAPH/LIST: GRAPHICS, KNOB SWEEP	
Saving screen images to a file	all	PCL, HR PCL, HP-GL, TIFF or HR TIFF
Saving setup data lists to a file	all setup ¹	PCL, HR PCL or HP-GL
Saving measurement data lists to a file	GRAPH/LIST: LIST	
Saving measurement data graphs to a file	GRAPH/LIST: GRAPHICS, KNOB SWEEP	PCL, HR PCL, HP-GL or HR TIFF

1. All setup screens, except for GRAPH/LIST and KNOB SWEEP.

Print/Plot Function
Output Formats

Differences Between PCL, HR PCL and HP-GL

There are major differences between the PCL, HR PCL and HP-GL modes for making hard copies. Use the comparison below to decide which mode is best for your needs.

	Mode	Description
Supported Peripheral	PCL	HP DeskJet, LaserJet, ThinkJet, PaintJet printers and HP C1202A serial printer
	HR PCL	
	HP-GL	HP DeskJet 1200C/1600C, LaserJet 4/4L printers and plotters
Screen Dump Output	PCL	Position is defined by OUTPUT REGION. Size depends on the OUTPUT REGION and RESOLUTION settings. RESOLUTION setting does not change the output quality. Aspect ratio cannot be changed. Print speed is faster than HR PCL.
	HR PCL	Position, size and aspect ratio are defined by OUTPUT REGION. Output resolution/quality depends on RESOLUTION setting.
	HP-GL	Position, size and aspect ratio are defined by OUTPUT REGION. Print speed is faster than PCL.
Data List Output	PCL	Print starting point is defined by OUTPUT REGION. Text font size depends on printer. RESOLUTION setting is ignored.
	HR PCL	Same as PCL.
	HP-GL	Position and text font size are defined by OUTPUT REGION. Print speed is faster than PCL.
Graph Output	PCL	Position is defined by OUTPUT REGION. Graph size depends on the OUTPUT REGION and RESOLUTION settings. Graph aspect ratio cannot be changed. Text font size depends on printer. RESOLUTION setting does not change the output quality. Print speed is faster than HR PCL.
	HR PCL	Position, size, and aspect ratio are defined by OUTPUT REGION. Output resolution/quality depends on RESOLUTION setting. All fonts are scaled with the output region.
	HP-GL	Position, size and aspect ratio are defined by OUTPUT REGION. All fonts are scaled with the output region. Print speed is faster than PCL.

Output Resolution

If you select the HR PCL or HR TIFF mode, you can change the resolution of the output. High resolution improves the output quality, but takes longer to print.

You can choose 75, 90, 100, 150, 180, 300 or 600 dpi (dots per inch) in the RESOLUTION field. This field appears in the PRINT/PLOT, GRAPH PLOT or SCREEN DUMP dialog box.

For the resolutions available for your printer, see “Supported Peripherals” on page 4-6.

RESOLUTION setting for PCL mode

In PCL mode, the RESOLUTION and OUTPUT REGION fields change the size and position of the output, but do not affect the output quality.

To set the output size and position, do the following procedure in the PRINT/PLOT, GRAPH PLOT or SCREEN DUMP dialog box.

1. In the RESOLUTION field, select one softkey (75 DPI to 600 DPI). A high RESOLUTION setting allows you to select various output sizes.
2. In the UPPER LEFT field, specify the upper-left corner position of the output image using the front-panel keys, rotary knob or keyboard, as follows:

UPPER LEFT X 0% Y 0%

The value may be 0% to 100%.

3. In the LOWER RIGHT field, specify the lower-right corner position of the output image using the rotary knob. The values available for the present RESOLUTION and UPPER LEFT settings are automatically calculated and displayed in the fields. You *cannot* change the aspect ratio of the output.

If the value exceeds 100%, change the RESOLUTION or UPPER LEFT settings. The value must be 0% to 100%.

Print/Plot Function
Supported Peripherals

Supported Peripherals

The 4155B/4156B supports the following peripherals. Use the table below to select the printer or plotter that best meets your needs.

Model	Interface	Output Format	Color ^a	P/L ^b	Output Resolution (dpi) ^c
HP DeskJet 340	Parallel	PCL, HR PCL	B/W, FIX ^d	P	75, 100, 150, 300
HP DeskJet 500 (C2106A)	Parallel	PCL, HR PCL	B/W	P	75, 150, 300
HP DeskJet 500C (C2114A)	Parallel	PCL	B/W, FIX	P	75, 150, 300
HP DeskJet 550C	Parallel	PCL, HR PCL	B/W, FIX	P	75, 150, 300
HP DeskJet 560C (C2168A)	Parallel	PCL, HR PCL	B/W, FIX, COLOR ^e	P	75, 150, 300
HP DeskJet 660C (C2164A)	Parallel	PCL, HR PCL	B/W, FIX, COLOR ^e	P	75, 150, 300
HP DeskJet 850C	Parallel	PCL, HR PCL	B/W, FIX, COLOR ^e	P	75, 150, 300, 600 ^f
HP DeskJet 895Cxi ^g	Parallel	PCL, HR PCL	B/W, FIX	P	100, 150, 300
HP DeskJet 970Cxi ^g	Parallel	PCL, HR PCL	B/W, FIX	P	100, 150, 300
HP DeskJet 1200C (C1676A)	Parallel	PCL, HP-GL	B/W, FIX, COLOR	P/L	75, 150, 300
		HR PCL	B/W	P/L	75, 150, 300
HP DeskJet 1600C	Parallel	PCL, HP-GL	B/W, FIX, COLOR	P/L	75, 150, 300
		HR PCL	B/W	P/L	75, 150, 300
HP LaserJet 4/4L (C2001A)	Parallel	PCL, HR PCL, HP-GL	B/W	P/L	75, 150, 300, 600
HP LaserJet 5L	Parallel	PCL, HR PCL	B/W	P/L	75, 100, 150, 180, 300
HP C1202A serial printer	GPIO	PCL	B/W	P	90, 150
HP ThinkJet (2225A/C/D)	GPIO, Parallel	PCL	B/W	P	75
HP PaintJet (3630A)	GPIO	PCL	B/W, FIX, COLOR	P	
HP 7440A/7475A plotters	GPIO	HP-GL	B/W, FIX	L	
HP 7550B plotter	GPIO	HP-GL	B/W, FIX	L	

Print/Plot Function Supported Peripherals

- a. Available parameters for the COLOR/ B/W field on the PRINT/PLOT SETUP screen:
B/W = Black & White mode, FIX = Fixed color mode, COLOR = Color mode.
- b. P = Portrait, L = Landscape
- c. Available values for the output resolution setting.
- d. For screen image dump only.
- e. COLOR mode is available for HR PCL only. Available number of colors is 8.
- f. 600 dpi for B/W only.
- g. Printer will blink its Form Feed indicator after successful printing. Press form feed button of the printer to stop blinking.

Connecting Peripherals

The 4155B/4156B has both GPIB and parallel interfaces for connecting peripherals.

To connect the peripheral to the interface connector, use one of the following cables:

GPIB: Agilent 10833A/B/C/D GPIB cable or equivalent

parallel: HP C2950A/C2951A printer cable or equivalent

For more information on connecting peripherals, see "Connecting Instruments or Peripherals" in Chapter 2.

If you use a remote printer via your printer server, connect the 4155B/4156B to your LAN. For more information, see "To Connect to a LAN" in Chapter 2 and "SYSTEM: MISCELLANEOUS screen" in Chapter 5.

Printing/Plotting Screen Images

This section describes how to make hard copies of the screen images using a printer or a plotter.

Before beginning to print/plot, check the following:

- **SYSTEM: MISCELLANEOUS** screen

This screen specifies the 4155B/4156B control mode, GPIB address, output equipment, and so on. Set all the entry fields properly. For more information, see “SYSTEM: MISCELLANEOUS screen” in Chapter 5.

- **SYSTEM: PRINT/PLOT SETUP** screen

This screen specifies the printer/plotter, information to print/plot, paper size, and so on. Set all the entry fields properly. For more information, see “SYSTEM: PRINT/PLOT SETUP screen” in Chapter 5.

The following entry fields must be set:

Entry Field	HP-GL	PCL	HR PCL
DESTINATION	√	√	√
FORM FEED	√	√	√
LINE			
COLUMN			
COLOR/B/W	√	√	√
PAPER	√	√	√
OUTPUT ITEM			
INIT STRING	√	√	√
TRAILER STRING	√	√	√

NOTE

Multiple Outputs

If you want to print two or more images on one sheet of paper, set the FORM FEED entry field to DISABLE for all images, except the last image. Set ENABLE for the last image.

Print/Plot Function Printing/Plotting Screen Images

To make a hard copy of a screen image:

1. Display the screen that you want to print out, then press:

- a. the front-panel green key
- b. Plot/Print key

The 4155B/4156B displays the SCREEN DUMP dialog box.

SCREEN DUMP			
*DESTINATION	PRINTER/PLOTTER		
*OUTPUT REGION			
UPPER LEFT	X 5%	Y 0%	
LOWER RIGHT	X 100%	Y 100%	
*LANGUAGE		*RESOLUTION	
PCL		75 DPI	

SCREEN DUMP			
*DESTINATION	PRINTER/PLOTTER		
*OUTPUT REGION			
UPPER LEFT	X 5%	Y 0%	
LOWER RIGHT	X 100%	Y 100%	
*LANGUAGE			
HP-GL			

In this dialog box, three softkeys are available:

- | | |
|--------------------|--|
| PRINT/PLOT | Executes the screen dump. |
| PR/PL SETUP | Displays the PRINT/PLOT SETUP screen. To close the PRINT/PLOT SETUP screen, select EXIT softkey. |
| EXIT | Closes the SCREEN DUMP dialog box and quits the print/plot function. |

2. To set the DESTINATION to PRINTER/PLOTTER, select PRINTER/PLOTTER softkey.

Print/Plot Function

Printing/Plotting Screen Images

3. To set the LANGUAGE, select PCL, HR PCL, or HP-GL softkey.

If you select the PCL or HR PCL mode, set the RESOLUTION by selecting one softkey: 75 DPI to 600 DPI. For more information on selecting resolution, see "Output Resolution" on page 4-5.

If you select the HR PCL mode, setting the resolution too low will result in poor print quality.

4. If you select HR PCL or HP-GL, set the OUTPUT REGION. There are two available fields:

UPPER LEFT Specifies the position of the upper-left corner of the printed or plotted hard copy.

LOWER RIGHT Specifies the position of the lower-right corner of the printed or plotted hard copy.

Select one of the softkeys, or enter a value using the keyboard or the ENTRY keys on the front panel. The following softkeys are available for each OUTPUT REGION field:

WHOLE Sets the output region as the entire sheet.

UPPER LEFT Sets the output region to the upper-left quarter of the paper.

UPPER RIGHT Sets the output region to the upper-right quarter of the paper.

LOWER LEFT Sets the output region to the lower-left quarter of the paper.

LOWER RIGHT Sets the output region to the lower-right quarter of the paper.

STORE REGION Stores the OUTPUT REGION settings in the internal memory.

RECALL REGION Recalls the latest settings stored in the internal memory.

To set the output region to the upper half of the paper, it should be defined as follows:

```
*OUTPUT REGION
UPPER LEFT  X  0%  Y  0%  <--origin of printer
LOWER RIGHT X 100% Y 50%
```

5. To start the screen dump, select PRINT/PLOT softkey.
6. To close the SCREEN DUMP dialog box, select EXIT softkey.

Printing/Plotting Setup Data Lists

This section describes how to print/plot the data list on the setup screens, except for the GRAPH/LIST and KNOB SWEEP screens.

Before beginning to print/plot, check the following:

- SYSTEM: MISCELLANEOUS screen

This screen specifies the 4155B/4156B control mode, GPIB address, output equipment, and so on. Set all the entry fields properly. For more information, see “SYSTEM: MISCELLANEOUS screen” in Chapter 5.

- SYSTEM: PRINT/PLOT SETUP screen

This screen specifies the printer/plotter, information to print/plot, paper size, and so on. Set all the entry fields properly. For more information, see “SYSTEM: PRINT/PLOT SETUP screen” in Chapter 5.

The following entry fields must be set:

Entry Field	HP-GL	PCL	HR PCL
DESTINATION	√	√	√
FORM FEED	√	√	√
LINE	√	√	√
COLUMN	√		√
COLOR/B/W	√	√	√
PAPER	√	√	√
OUTPUT ITEM	√	√	√
INIT STRING	√	√	√
TRAILER STRING	√	√	√

NOTE

Multiple Outputs

If you want to print two or more images on one sheet of paper, set the FORM FEED entry field to DISABLE for all images, except the last image. Set ENABLE for the last image.

Print/Plot Function

Printing/Plotting Setup Data Lists

To print/plot the setup data list:

1. Display the setup screen you want to print/plot, then press:

- Plot/Print key

The 4155B/4156B displays the PRINT/PLOT SETUP DATA dialog box.

PRINT/PLOT SETUP DATA			
*DESTINATION	PRINTER/PLOTTER		
*OUTPUT REGION			
UPPER LEFT	X 5%	Y 0%	*OUTPUT PAGE CURRENT
*PRINT/PLOT COMMENT	PCL		*RESOLUTION 75 DPI

PRINT/PLOT SETUP DATA			
*DESTINATION	PRINTER/PLOTTER		
*OUTPUT REGION			
UPPER LEFT	X 5%	Y 0%	*OUTPUT PAGE CURRENT
LOWER RIGHT	X 100%	Y 100%	
*PRINT/PLOT COMMENT	HP-GL		*LANGUAGE

In this dialog box, three softkeys are available:

- | | |
|--------------------|--|
| PRINT/PLOT | Executes the printing/plotting. |
| PR/PL SETUP | Displays the PRINT/PLOT SETUP screen. To close the PRINT/PLOT SETUP screen, select EXIT softkey. |
| EXIT | Closes the PRINT/PLOT SETUP DATA dialog box and quits the print/plot function. |

2. To set the DESTINATION to PRINTER/PLOTTER, select PRINTER/PLOTTER softkey.
3. To set the LANGUAGE, select PCL, HR PCL, or HP-GL softkey.

If you select PCL or HR PCL, ignore the RESOLUTION setting. The text font size depends on the printer you use.

Print/Plot Function
Printing/Plotting Setup Data Lists

4. To specify the OUTPUT PAGE, select one of the following softkeys:

CURRENT	Selects the currently displayed setup screen.
GROUP	Selects the screen group that includes the currently displayed setup data.
ALL	Selects all the setup screens.

5. To set the OUTPUT REGION, enter the following entry fields.

UPPER LEFT	Specifies the position of the upper-left corner of the printed or plotted hard copy.
LOWER RIGHT	Specifies the position of the lower-right corner of the printed or plotted hard copy. (If you set the LANGUAGE to PCL or HR PCL, ignore the LOWER RIGHT entry fields.)

Select one of the following softkeys, or enter a value using the keyboard or the ENTRY keys on the front panel. These softkeys are available for each OUTPUT REGION field.

WHOLE	Sets the output region as the entire sheet.
UPPER LEFT	Sets the output region to the upper-left quarter of the paper.
UPPER RIGHT	Sets the output region to the upper-right quarter of the paper.
LOWER LEFT	Sets the output region to the lower-left quarter of the paper.
LOWER RIGHT	Sets the output region to the lower-right quarter of the paper.
STORE REGION	Stores the OUTPUT REGION settings in the internal memory.
RECALL REGION	Recalls the latest settings stored in the internal memory.

To set the output region to the upper half of the paper, the OUTPUT REGION should be defined as follows:

```
*OUTPUT REGION
UPPER LEFT  X   0%   Y   0%  <--origin of printer
LOWER RIGHT X 100%   Y  50%
```

6. Optional: Enter a comment of up to 58 characters into the PRINT/PLOT COMMENT field. This comment is printed only when this field is enabled on the SYSTEM: PRINT/PLOT SETUP screen.
7. To start printing/plotting, select PRINT/PLOT softkey.
8. To close the PRINT/PLOT SETUP DATA dialog box, select EXIT softkey.

Printing/Plotting Measurement Data Lists

This section describes how to print/plot the list of measurement results displayed on the GRAPH/LIST: LIST screen.

Before beginning to print/plot, check the following:

- SYSTEM: MISCELLANEOUS screen

This screen specifies the 4155B/4156B control mode, GPIB address, output equipment, and so on. Set all the entry fields properly. For more information, see "SYSTEM: MISCELLANEOUS screen" in Chapter 5.

- SYSTEM: PRINT/PLOT SETUP screen

This screen specifies the printer/plotter, information to print/plot, paper size, and so on. Set all the entry fields properly. For more information, see "SYSTEM: PRINT/PLOT SETUP screen" in Chapter 5.

The following entry fields must be set:

Entry Field	HP-GL	PCL	HR PCL
DESTINATION	√	√	√
FORM FEED	√	√	√
LINE	√	√	√
COLUMN	√		√
COLOR/B/W	√	√	√
PAPER	√	√	√
OUTPUT ITEM	√	√	√
INIT STRING	√	√	√
TRAILER STRING	√	√	√

NOTE

Multiple Outputs

If you want to print two or more images on one sheet of paper, set the FORM FEED entry field to DISABLE for all images, except the last image. Set ENABLE for the last image.

Print/Plot Function Printing/Plotting Measurement Data Lists

To print/plot the measurement result list:

1. Display the GRAPH/LIST: LIST screen, then press:

- Plot/Print key

The 4155B/4156B displays the PRINT/PLOT DATA LIST dialog box.

PRINT/PLOT DATA LIST			
*DESTINATION	<div style="border: 1px solid black; padding: 2px; display: inline-block;">PRINTER/PLOTTER</div>		
*OUTPUT REGION	UPPER LEFT	X 5% Y 0%	*OUTPUT DATA (INDEX NO) 1 <--> MAX
*PRINT/PLOT COMMENT	<div style="display: flex; justify-content: space-between;"> <div style="width: 40%;"></div> <div style="width: 20%; padding: 5px;">PCL</div> <div style="width: 20%; padding: 5px;">75 DPI</div> <div style="width: 20%;"></div> </div> <div style="border: 1px solid black; height: 20px; margin-top: 5px;"></div>		

PRINT/PLOT DATA LIST			
*DESTINATION	<div style="border: 1px solid black; padding: 2px; display: inline-block;">PRINTER/PLOTTER</div>		
*OUTPUT REGION	UPPER LEFT	X 5% Y 0%	*OUTPUT DATA (INDEX NO) 1 <--> MAX
	LOWER RIGHT	X 100% Y 100%	
*PRINT/PLOT COMMENT	<div style="display: flex; justify-content: space-between;"> <div style="width: 40%;"></div> <div style="width: 20%; padding: 5px;">HP-GL</div> <div style="width: 20%;"></div> <div style="width: 20%;"></div> </div> <div style="border: 1px solid black; height: 20px; margin-top: 5px;"></div>		

In this dialog box, three softkeys are available:

- | | |
|--------------------|--|
| PRINT/PLOT | Executes the printing/plotting. |
| PR/PL SETUP | Displays the PRINT/PLOT SETUP screen. To close the PRINT/PLOT SETUP screen, select EXIT softkey. |
| EXIT | Closes the PRINT/PLOT DATA LIST dialog box and quits the print/plot function. |

2. To set the DESTINATION to the PRINTER/PLOTTER, select PRINTER/PLOTTER softkey.

3. To set the LANGUAGE, select PCL, HR PCL, or HP-GL softkey.

If you select PCL or HR PCL, ignore the RESOLUTION setting. The text font size depends on the printer you use.

Print/Plot Function

Printing/Plotting Measurement Data Lists

4. To set the OUTPUT DATA (INDEX NO) to be printed/plotted:

- a. Select the data INDEX numbers 1 to 100, entering the following:

*OUTPUT DATA (INDEX NO)

1 <--> 100

- b. Select all measurement data by selecting ALL softkey.

5. To set the OUTPUT REGION, enter the following entry fields.

UPPER LEFT Specifies the position of the upper-left corner of the printed or plotted hard copy.

LOWER RIGHT Specifies the position of the lower-right corner of the printed or plotted hard copy. (If you set the LANGUAGE to PCL or HR PCL, ignore the LOWER RIGHT field.)

Select one of the following softkeys, or enter a value using the keyboard or the ENTRY keys on the front panel. These softkeys are available for each OUTPUT REGION field:

WHOLE Sets the output region as the entire sheet.

UPPER LEFT Sets the output region to the upper-left quarter of the paper.

UPPER RIGHT Sets the output region to the upper-right quarter of the paper.

LOWER LEFT Sets the output region to the lower-left quarter of the paper.

LOWER RIGHT Sets the output region to the lower-right quarter of the paper.

STORE REGION Stores the OUTPUT REGION settings in the internal memory.

RECALL REGION Recalls the latest settings stored in the internal memory.

To set the output region to the upper half of the paper, the OUTPUT REGION should be defined as follows:

*OUTPUT REGION

UPPER LEFT X 0% Y 0% <--origin of printer

LOWER RIGHT X 100% Y 50%

6. Optional: Enter a comment of up to 58 characters in the PRINT/PLOT COMMENT field. This comment is printed only when this field is enabled on the SYSTEM: PRINT/PLOT SETUP screen.
7. To start printing/plotting, select PRINT/PLOT softkey.
8. To close the PRINT/PLOT DATA LIST dialog box, select EXIT softkey.

Printing/Plotting Measurement Data Graphs

This section describes how to print/plot a graph of the measurement results on the GRAPH/LIST: GRAPHICS screen.

Before beginning to print/plot, check the following:

- SYSTEM: MISCELLANEOUS screen

This screen specifies the 4155B/4156B control mode, GPIB address, output equipment, and so on. Set all the entry fields properly. For more information, see “SYSTEM: MISCELLANEOUS screen” in Chapter 5.

- SYSTEM: PRINT/PLOT SETUP screen

This screen specifies the printer/plotter, information to print/plot, paper size, and so on. Set all the entry fields properly. For more information, see “SYSTEM: PRINT/PLOT SETUP screen” in Chapter 5.

The following entry fields must be set:

Entry Field	HP-GL	PCL	HR PCL
DESTINATION	√	√	√
FORM FEED	√	√	√
LINE	√	√	√
COLUMN	√		√
COLOR/B/W	√	√	√
PAPER	√	√	√
OUTPUT ITEM	√	√	√
INIT STRING	√	√	√
TRAILER STRING	√	√	√

NOTE

Multiple Outputs

If you want to print two or more images on one sheet of paper, set the FORM FEED entry field to DISABLE for all images, except the last image. Set ENABLE for the last image.

Print/Plot Function

Printing/Plotting Measurement Data Graphs

To print/plot a measurement result graph:

1. Display the GRAPH/LIST: GRAPHICS screen, then press:

- Plot/Print key

The 4155B/4156B displays the GRAPH PLOT dialog box.

GRAPH PLOT			
*DESTINATION	PRINTER/PLOTTER		
*OUTPUT REGION			
UPPER LEFT	X 5%	Y 0%	*PRINT SETUP DATA YES
LOWER RIGHT	X 100%	Y 100%	
*PRINT/PLOT COMMENT			
	*LANGUAGE PCL	*RESOLUTION 75 DPI	

GRAPH PLOT			
*DESTINATION	PRINTER/PLOTTER		
*OUTPUT REGION			
UPPER LEFT	X 5%	Y 0%	*GRAPH TRACE ONLY NO
LOWER RIGHT	X 100%	Y 100%	*PRINT SETUP DATA YES
			POSITION BOTTOM
*PRINT/PLOT COMMENT			
	*LANGUAGE HR PCL	*RESOLUTION 75 DPI	

GRAPH PLOT			
*DESTINATION	PRINTER/PLOTTER		
*OUTPUT REGION			
UPPER LEFT	X 5%	Y 0%	*GRAPH TRACE ONLY NO
LOWER RIGHT	X 100%	Y 100%	*PRINT SETUP DATA YES
			POSITION BOTTOM
*PRINT/PLOT COMMENT			
	*LANGUAGE HP-GL		

Print/Plot Function Printing/Plotting Measurement Data Graphs

In this dialog box, three softkeys are available:

- | | |
|--------------------|--|
| PRINT/PLOT | Executes the printing/plotting. |
| PR/PL SETUP | Displays the PRINT/PLOT SETUP screen. To close the PRINT/PLOT SETUP screen, select EXIT softkey. |
| EXIT | Closes the GRAPH PLOT dialog box and quits the print/plot function. |

2. To set the DESTINATION to the PRINTER/PLOTTER, select PRINTER/PLOTTER softkey.
3. To set the LANGUAGE, select PCL, HR PCL, or HP-GL softkey.

If you select the PCL or HR PCL mode, set RESOLUTION by selecting one softkey: 75 DPI to 600 DPI. For more information on selecting resolution, see "Output Resolution" on page 4-5.

If you select the HR PCL mode, setting the resolution too low will result in poor print quality.

4. If you select HR PCL or HP-GL, set the GRAPH TRACE ONLY field by selecting YES or NO softkey.

- | | |
|------------|--|
| YES | Graph trace only output. |
| NO | Outputs the graph information enabled on PRINT/PLOT SETUP screen OUTPUT ITEM fields. |

5. Set the PRINT SETUP DATA field by selecting YES or NO softkey.

- | | |
|------------|-------------------------------|
| YES | Graph output with setup data. |
| NO | Graph output only. |

If you select YES, set the POSITION entry field. (For PCL, the POSITION field is not displayed and is always set to BOTTOM.)

- | | |
|---------------|--|
| BOTTOM | Places the setup data below the graph. |
| RIGHT | Places the setup data to the right of the graph. |

6. If you select HR PCL or HP-GL, set the OUTPUT REGION. There are two available fields:

- | | |
|--------------------|---|
| UPPER LEFT | Specifies the position of the upper-left corner of the printed or plotted hard copy. |
| LOWER RIGHT | Specifies the position of the lower-right corner of the printed or plotted hard copy. |

Print/Plot Function

Printing/Plotting Measurement Data Graphs

Select one of the following softkeys, or enter a value using the keyboard or the ENTRY keys on the front panel. These softkeys are available for each OUTPUT REGION field.

WHOLE	Sets the output region as the entire sheet.
UPPER LEFT	Sets the output region to the upper-left quarter of the paper.
UPPER RIGHT	Sets the output region to the upper-right quarter of the paper.
LOWER LEFT	Sets the output region to the lower-left quarter of the paper.
LOWER RIGHT	Sets the output region to the lower-right quarter of the paper.
STORE REGION	Stores the OUTPUT REGION settings in the internal memory.

RECALL REGION Recalls the latest settings stored in the internal memory.

If you want to set the output region to the upper half of the paper, the OUTPUT REGION should be defined as follows:

```
*OUTPUT REGION
UPPER LEFT  X  0%  Y  0%  <--origin of printer
LOWER RIGHT X 100% Y  50%
```

- Optional: Enter a comment of up to 58 characters in the PRINT/PLOT COMMENT field. This comment is printed only when this field is enabled on the SYSTEM: PRINT/PLOT SETUP screen.
- To start printing/plotting, select PRINT/PLOT softkey.
- To close the GRAPH PLOT dialog box, select EXIT softkey.

Saving Screen Images

This section describes how to save screen images (screen dump information).

Before beginning to save the setup data list, check the following:

- **SYSTEM: FILER screen**

This screen sets the DISK entry field to specify the mass storage device used to save a PCL, HP-GL, or TIFF file. See “SYSTEM: FILER screen” in Chapter 5.

- **SYSTEM: PRINT/PLOT SETUP screen**

This screen specifies the information to save, paper size, and so on. Set all the entry fields properly. For more information, see “SYSTEM: PRINT/PLOT SETUP screen” in Chapter 5.

The following entry fields must be set:

Entry Field	HP-GL	PCL	HR PCL	TIFF	HR TIFF
DESTINATION					
FORM FEED	√	√	√		
LINE					
COLUMN					
COLOR/B/W	√	√	√	√	√
PAPER	√	√	√		
OUTPUT ITEM					
INIT STRING	√	√	√		
TRAILER STRING	√	√	√		

Print/Plot Function

Saving Screen Images

To save the screen images:

1. Display the screen that you want to print out, then press:

- a. the front-panel green key
- b. Plot/Print key

The 4155B/4156B displays the SCREEN DUMP dialog box.

SCREEN DUMP			
*DESTINATION	<input type="text" value="FILE"/>		*FILE NAME <input type="text"/>
*OUTPUT REGION			
UPPER LEFT	<input type="text" value="X 5%"/>	<input type="text" value="Y 0%"/>	
LOWER RIGHT	<input type="text" value="X 100%"/>	<input type="text" value="Y 100%"/>	
		*LANGUAGE <input type="text" value="PCL"/>	*RESOLUTION <input type="text" value="75 DPI"/>

In this dialog box, three softkeys are available:

- | | |
|--------------------|--|
| PRINT/PLOT | Executes the screen image save. |
| PR/PL SETUP | Displays the PRINT/PLOT SETUP screen. To close the PRINT/PLOT SETUP screen, select EXIT softkey. |
| EXIT | Closes the SCREEN DUMP dialog box and quits the print/plot function. |

2. To set the DESTINATION to FILE, select FILE softkey.

3. Enter the file name in the FILE NAME field.

To save a file to a diskette in the built-in flexible disk drive, the file name must be:

- a maximum of 8 characters for DOS format
- a maximum of 6 characters for HP LIF format (Do not use "_" as the last character of the filename.)

To save a file to the network drive, the file name can be a maximum of 36 characters. The file name and directory path can be a maximum of 58 characters.

Print/Plot Function Saving Screen Images

4. To set the LANGUAGE, select PCL, HR PCL, HP-GL, TIFF or HR TIFF softkey.

If you select PCL, HR PCL, or HR TIFF mode, set the RESOLUTION by selecting one softkey: 75 DPI to 600 DPI. For more information on selecting resolution, see "Output Resolution" on page 4-5.

If you select the HR PCL mode, setting the resolution too low will result in poor print quality.

5. If you select HR PCL or HP-GL, set the OUTPUT REGION. There are two available fields:

UPPER LEFT Specifies the position of the upper-left corner of the printed or plotted hard copy.

LOWER RIGHT Specifies the position of the lower-right corner of the printed or plotted hard copy.

Select one of the following softkeys, or enter a value using the keyboard or the ENTRY keys on the front panel. These softkeys are available for each OUTPUT REGION field:

WHOLE Sets the output region as the entire sheet.

UPPER LEFT Sets the output region to the upper-left quarter of the paper.

UPPER RIGHT Sets the output region to the upper-right quarter of the paper.

LOWER LEFT Sets the output region to the lower-left quarter of the paper.

LOWER RIGHT Sets the output region to the lower-right quarter of the paper.

STORE REGION Stores the OUTPUT REGION settings in the internal memory.

RECALL REGION Recalls the latest settings stored in the internal memory.

To set the output region to the upper half of the paper, the OUTPUT REGION should be defined as follows:

```
*OUTPUT REGION
UPPER LEFT  X  0%  Y  0%  <--origin of printer
LOWER RIGHT X 100% Y  50%
```

6. To start to save the screen image, select PRINT/PLOT softkey.
7. To close the SCREEN DUMP dialog box, select EXIT softkey.

Saving Setup Data Lists

This section describes how to save the setup data list on setup screens, except for the GRAPH/LIST and KNOB SWEEP screens, as a PCL or HP-GL file.

Before beginning to save the setup data list, check the following:

- **SYSTEM: FILER screen**

This screen sets the DISK entry field to specify the mass storage device used to save a PCL or HP-GL file. For more information, see “SYSTEM: FILER screen” in Chapter 5.

- **SYSTEM: PRINT/PLOT SETUP screen**

This screen specifies the information to save, paper size, and so on. Set all the entry fields properly. For more information, see “SYSTEM: PRINT/PLOT SETUP screen” in Chapter 5.

The following entry fields must be set:

Entry Field	HP-GL	PCL	HP PCL
DESTINATION			
FORM FEED	√	√	√
LINE	√	√	√
COLUMN	√		√
COLOR/B/W	√	√	√
PAPER	√	√	√
OUTPUT ITEM	√	√	√
INIT STRING	√	√	√
TRAILER STRING	√	√	√

Print/Plot Function Saving Setup Data Lists

To save the setup data list:

1. Display the setup screen you want to save, then press:

- Plot/Print key

The 4155B/4156B displays the PRINT/PLOT SETUP DATA dialog box:

PRINT/PLOT SETUP DATA			
*DESTINATION	FILE	*FILE NAME	
		*OUTPUT PAGE	CURRENT
		*LANGUAGE	PCL
*PRINT/PLOT COMMENT		*RESOLUTION	75 DPI

PRINT/PLOT SETUP DATA			
*DESTINATION	FILE	*FILE NAME	
*OUTPUT REGION		*OUTPUT PAGE	CURRENT
UPPER LEFT	X 5%	Y 0%	
LOWER RIGHT	X 100%	Y 100%	
		*LANGUAGE	HP-GL
*PRINT/PLOT COMMENT			

In this dialog box, three softkeys are available:

- | | |
|--------------------|--|
| PRINT/PLOT | Executes the file save. |
| PR/PL SETUP | Displays the PRINT/PLOT SETUP screen. To close the PRINT/PLOT SETUP screen, select EXIT softkey. |
| EXIT | Closes the PRINT/PLOT SETUP DATA dialog box and quits the print/plot function. |

2. To set the DESTINATION to FILE, select FILE softkey.

Print/Plot Function

Saving Setup Data Lists

3. Enter the file name in the FILE NAME entry field.

To save a file to a diskette in the built-in flexible disk drive, the file name must be:

- a maximum of 8 characters for DOS format
- a maximum of 6 characters for HP LIF format (Do not use "_" as the last character of the filename.)

To save a file to the network drive, the file name can be a maximum of 36 characters. The file name and directory path can be a maximum of 58 characters.

4. To set the LANGUAGE, select PCL, HR PCL, or HP-GL softkey.

If you select the PCL or HR PCL mode, ignore the RESOLUTION setting. The text font size depends on the printer you use.

5. To specify the OUTPUT PAGE, select one of the following softkeys.

CURRENT	Selects the currently displayed setup screen.
GROUP	Selects the screen group that includes the currently displayed setup data.
ALL	Selects all the setup screens.

6. If you select HP-GL, set the OUTPUT REGION. There are two available fields:

UPPER LEFT	Specifies the position of the upper-left corner of the printed or plotted hard copy.
LOWER RIGHT	Specifies the position of the lower-right corner of the printed or plotted hard copy.

Select one of the following softkeys, or enter a value using the keyboard or the ENTRY keys on the front panel. These softkeys are available for each OUTPUT REGION field.

WHOLE	Sets the output region as the entire sheet.
UPPER LEFT	Sets the output region to the upper-left quarter of the paper.
UPPER RIGHT	Sets the output region to the upper-right quarter of the paper.
LOWER LEFT	Sets the output region to the lower-left quarter of the paper.
LOWER RIGHT	Sets the output region to the lower-right quarter of the paper.

Print/Plot Function Saving Setup Data Lists

STORE REGION Stores the OUTPUT REGION settings in the internal memory.

RECALL REGION Recalls the latest settings stored in the internal memory.

To set the output region to the upper half of the paper, the OUTPUT REGION should be defined as follows:

```
*OUTPUT REGION
UPPER LEFT  X  0%  Y  0%  <--origin of printer
LOWER RIGHT X 100% Y  50%
```

7. Optional: Enter a comment of up to 58 characters in the PRINT/PLOT COMMENT field. This comment is printed only when this field is enabled on the SYSTEM: PRINT/PLOT SETUP screen.
8. To start the file save, select PRINT/PLOT softkey.
9. To close the PRINT/PLOT SETUP DATA dialog box, select EXIT softkey.

Saving Measurement Data Lists

This section describes how to save the list of measurement results displayed on the GRAPH/LIST: LIST screen as a PCL or HP-GL file.

Before beginning to save the measurement data list, check the following:

- **SYSTEM: FILER screen**

This screen sets the DISK entry field to specify the mass storage device used to save a PCL or HP-GL file. See “SYSTEM: FILER screen” in Chapter 5.

- **SYSTEM: PRINT/PLOT SETUP screen**

This screen specifies the information to save, paper size, and so on. Set all the entry fields properly. See “SYSTEM: PRINT/PLOT SETUP screen” in Chapter 5.

The following entry fields must be set:

Entry Field	HP-GL	PCL	HP PCL
DESTINATION			
FORM FEED	√	√	√
LINE	√	√	√
COLUMN	√		√
COLOR/B/W	√	√	√
PAPER	√	√	√
OUTPUT ITEM	√	√	√
INIT STRING	√	√	√
TRAILER STRING	√	√	√

Print/Plot Function Saving Measurement Data Lists

To save the measurement result list:

1. Display the GRAPH/LIST: LIST screen, then press:

- Plot/Print key

The 4155B/4156B displays the PRINT/PLOT DATA LIST dialog box.

PRINT/PLOT DATA LIST			
*DESTINATION	<div style="border: 1px solid black; display: inline-block; padding: 2px 10px;">FILE</div>	*FILE NAME	<div style="border: 1px solid black; display: inline-block; width: 150px; height: 1.2em;"></div>
		*OUTPUT DATA (INDEX NO)	<div style="border: 1px solid black; display: inline-block; padding: 2px 10px;">1 <--> MAX</div>
		*LANGUAGE	<div style="border: 1px solid black; display: inline-block; padding: 2px 10px;">PCL</div>
*PRINT/PLOT COMMENT	<div style="border: 1px solid black; display: inline-block; padding: 2px 10px;">75 DPI</div>		
<div style="border: 1px solid black; height: 1.2em; width: 100%;"></div>			

PRINT/PLOT DATA LIST			
*DESTINATION	<div style="border: 1px solid black; display: inline-block; padding: 2px 10px;">FILE</div>	*FILE NAME	<div style="border: 1px solid black; display: inline-block; width: 150px; height: 1.2em;"></div>
		*OUTPUT DATA (INDEX NO)	<div style="border: 1px solid black; display: inline-block; padding: 2px 10px;">1 <--> MAX</div>
		*LANGUAGE	<div style="border: 1px solid black; display: inline-block; padding: 2px 10px;">HP-GL</div>
		<div style="border: 1px solid black; height: 1.2em; width: 100%;"></div>	

In this dialog box, three softkeys are available:

- | | |
|--------------------|--|
| PRINT/PLOT | Executes the file save. |
| PR/PL SETUP | Displays the PRINT/PLOT SETUP screen. To close the PRINT/PLOT SETUP screen, select EXIT softkey. |
| EXIT | Closes the PRINT/PLOT DATA LIST dialog box and quits the print/plot function. |

2. To set the DESTINATION to FILE, select FILE softkey.

Print/Plot Function

Saving Measurement Data Lists

3. Enter the file name into the FILE NAME entry field.

To save a file to a diskette in the built-in flexible disk drive, the file name must be:

- a maximum of 8 characters for DOS format
- a maximum of 6 characters for HP LIF format (Do not use "_" as the last character of the filename.)

To save a file to the network drive, the file name can be a maximum of 36 characters. The file name and directory path can be a maximum of 58 characters.

4. To set the LANGUAGE, select PCL, HR PCL, or HP-GL softkey.

If you select PCL or HR PCL, ignore the RESOLUTION setting. The text font size depends on the printer you use.

5. Set the OUTPUT DATA (INDEX NO) to be saved.

- a. Select the data INDEX numbers 1 to 100, by entering the following:

```
*OUTPUT DATA (INDEX NO)
  _____ 1 <--> _____ 100
```

- b. Select all the measurement data by selecting ALL softkey.

6. If you select HP-GL, set the OUTPUT REGION. There are two available fields:

UPPER LEFT Specifies the position of the upper-left corner of the printed or plotted hard copy.

LOWER RIGHT Specifies the position of the lower-right corner of the printed or plotted hard copy.

Select one of the following softkeys, or enter a value using the keyboard or the ENTRY keys on the front panel. These softkeys are available for each OUTPUT REGION field.

WHOLE Sets the output region as the entire sheet.

UPPER LEFT Sets the output region to the upper-left quarter of the paper.

UPPER RIGHT Sets the output region to the upper-right quarter of the paper.

LOWER LEFT Sets the output region to the lower-left quarter of the paper.

LOWER RIGHT Sets the output region to the lower-right quarter of the paper.

Print/Plot Function
Saving Measurement Data Lists

STORE REGION Stores the OUTPUT REGION settings in the internal memory.

RECALL REGION Recalls the latest settings stored in the internal memory.

To set the output region to the upper half of the paper, the OUTPUT REGION should be defined as follows:

```
*OUTPUT REGION
UPPER LEFT  X  0%  Y  0%  <--origin of printer
LOWER RIGHT X 100% Y  50%
```

7. Optional: Enter a comment of up to 58 characters in the PRINT/PLOT COMMENT entry field. This comment is printed only when this field is enabled on the SYSTEM: PRINT/PLOT SETUP screen.
8. To start the file save, select PRINT/PLOT softkey.
9. To close the PRINT/PLOT DATA LIST dialog box, select EXIT softkey.

Saving Measurement Data Graphs

This section describes how to save the list of measurement results displayed on the GRAPH/LIST: GRAPHICS screen as a PCL, HP-GL, or TIFF file.

Before beginning to save the measurement data graph, check the following:

- **SYSTEM: FILER screen**

This screen sets the DISK entry field to specify the mass storage device used to save a PCL, HP-GL, or TIFF file. See “SYSTEM: FILER screen” in Chapter 5.

- **SYSTEM: PRINT/PLOT SETUP screen**

This screen specifies the information to save, paper size for printing/plotting, and so on. Set all the entry fields properly. See “SYSTEM: PRINT/PLOT SETUP screen” in Chapter 5.

The following entry fields must be set:

Entry Field	HP-GL	PCL	HR PCL	HR TIFF
DESTINATION				
FORM FEED	√	√	√	
LINE	√	√	√	
COLUMN	√		√	
COLOR/B/W	√	√	√	√
PAPER	√	√	√	
OUTPUT ITEM	√	√	√	√
INIT STRING	√	√	√	
TRAILER STRING	√	√	√	

Print/Plot Function Saving Measurement Data Graphs

To save a measurement result graph:

1. Display the GRAPH/LIST: GRAPHICS screen, then press Plot/Print key.

The 4155B/4156B displays the GRAPH PLOT dialog box.

GRAPH PLOT			
*DESTINATION	<input type="text" value="FILE"/>	*FILE NAME	<input type="text"/>
*OUTPUT REGION			
UPPER LEFT	<input type="text" value="X 5%"/>	<input type="text" value="Y 0%"/>	*PRINT SETUP DATA <input type="text" value="YES"/>
LOWER RIGHT	<input type="text" value="X 100%"/>	<input type="text" value="Y 100%"/>	
*PRINT/PLOT COMMENT	<input type="text" value="PCL"/>	*LANGUAGE	*RESOLUTION <input type="text" value="75 DPI"/>
<input type="text"/>			

GRAPH PLOT			
*DESTINATION	<input type="text" value="FILE"/>	*FILE NAME	<input type="text"/>
*OUTPUT REGION			
UPPER LEFT	<input type="text" value="X 5%"/>	<input type="text" value="Y 0%"/>	*GRAPH TRACE ONLY <input type="text" value="NO"/>
LOWER RIGHT	<input type="text" value="X 100%"/>	<input type="text" value="Y 100%"/>	*PRINT SETUP DATA <input type="text" value="YES"/>
			POSITION <input type="text" value="BOTTOM"/>
*PRINT/PLOT COMMENT	<input type="text" value="HR PCL"/>	*LANGUAGE	*RESOLUTION <input type="text" value="75 DPI"/>
<input type="text"/>			

GRAPH PLOT			
*DESTINATION	<input type="text" value="FILE"/>	*FILE NAME	<input type="text"/>
*OUTPUT REGION			
UPPER LEFT	<input type="text" value="X 5%"/>	<input type="text" value="Y 0%"/>	*GRAPH TRACE ONLY <input type="text" value="NO"/>
LOWER RIGHT	<input type="text" value="X 100%"/>	<input type="text" value="Y 100%"/>	*PRINT SETUP DATA <input type="text" value="YES"/>
			POSITION <input type="text" value="BOTTOM"/>
*PRINT/PLOT COMMENT	<input type="text" value="HP-GL"/>	*LANGUAGE	
<input type="text"/>			

Print/Plot Function

Saving Measurement Data Graphs

GRAPH PLOT	
*DESTINATION	FILE
*FILE NAME	
*GRAPH TRACE ONLY	NO
*PRINT SETUP DATA	YES
POSITION	BOTTOM
*LANGUAGE	HR TIFF
*RESOLUTION	75 DPI
*PRINT/PLOT COMMENT	

In this dialog box, three softkeys are available:

- | | |
|--------------------|--|
| PRINT/PLOT | Executes the file save. |
| PR/PL SETUP | Displays the PRINT/PLOT SETUP screen. To close the PRINT/PLOT SETUP screen, select EXIT softkey. |
| EXIT | Closes the GRAPH PLOT dialog box and quits the print/plot function. |

- To set the DESTINATION to FILE, select FILE softkey.
- Enter the file name into the FILE NAME entry field.

To save a file to a diskette, the file name must be:

- a maximum of 8 characters for DOS format
- a maximum of 6 characters for HP LIF format (Do not use "_" as the last character of the filename.)

To save a file to the network drive, the file name can be a maximum of 36 characters. The file name and directory path can be a maximum of 58 characters.

- To set the LANGUAGE, select PCL, HR PCL, HP-GL or HR TIFF softkey.

If you select the PCL, HR PCL or HR TIFF mode, set the RESOLUTION by selecting one softkey: 75 DPI to 600 DPI. For more information on selecting the resolution, see "Output Resolution" on page 4-5.

If you select the HR PCL mode, setting the resolution too low will result in poor print quality.

Print/Plot Function
Saving Measurement Data Graphs

5. If you select HR PCL, HR TIFF or HP-GL, set the GRAPH TRACE ONLY field by selecting YES or NO softkey.

YES	Graph trace only output.
NO	Outputs the graph information enabled on PRINT/PLOT SETUP screen OUTPUT ITEM fields.

6. Set the PRINT SETUP DATA field by selecting YES or NO softkey.

YES	Graph output with setup data.
NO	Graph output only.

If you select YES, set the POSITION entry field. (For the PCL mode, the POSITION field is not displayed and is always set to BOTTOM.)

BOTTOM	Places the setup data below the graph.
RIGHT	Places the setup data to the right of the graph.

7. If you select HR PCL or HP-GL, set the OUTPUT REGION. There are two available fields:

UPPER LEFT	Specifies the position of the upper-left corner of the printed or plotted hard copy.
LOWER RIGHT	Specifies the position of the lower-right corner of the printed or plotted hard copy.

Select one of the following softkeys, or enter a value using the keyboard or the ENTRY keys on the front panel. These softkeys are available for each OUTPUT REGION field:

WHOLE	Sets the output region as the entire sheet.
UPPER LEFT	Sets the output region to the upper-left quarter of the paper.
UPPER RIGHT	Sets the output region to the upper-right quarter of the paper.
LOWER LEFT	Sets the output region to the lower-left quarter of the paper.
LOWER RIGHT	Sets the output region to the lower-right quarter of the paper.
STORE REGION	Stores the OUTPUT REGION settings in the internal memory.
RECALL REGION	Recalls the latest settings stored in the internal memory.

Print/Plot Function

Saving Measurement Data Graphs

To set the output region to the upper half of the paper, the OUTPUT REGION should be defined as follows:

```
*OUTPUT REGION
UPPER LEFT  X  0%  Y  0%  <--origin of printer
LOWER RIGHT X 100% Y  50%
```

8. Optional: Enter a comment of up to 58 characters in the PRINT/PLOT COMMENT field. This comment is printed only when this field is enabled on the SYSTEM: PRINT/PLOT SETUP screen.
9. To start printing/plotting, select PRINT/PLOT softkey.
10. To close the GRAPH PLOT dialog box, select EXIT softkey.

Output Examples

This section shows examples of the 4155B/4156B print/plot output.

- “Screen Dump Output”
- “Setup Data List Output”
- “Measurement Result List Output”
- “Measurement Result Graph Output”

Print/Plot Function
Output Examples

Screen Dump Output

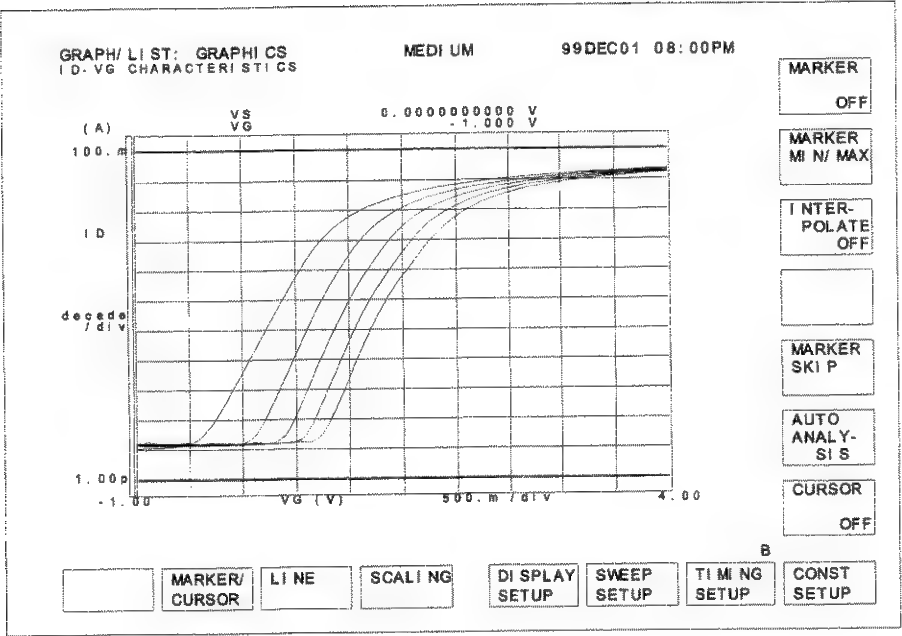
This is an example of the GRAPH/LIST: GRAPHICS screen dump, in HP-GL format, using an HP LaserJet printer in landscape mode.

Setup

- Screen: GRAPH/LIST: GRAPHICS
- USER COMMENT on the Screen:
ID-VG CHARACTERISTICS
- SYSTEM: PRINT/PLOT SETUP screen:
 - *FORM FEED ENABLE
 - *COLOR/B/W B/W
 - *PAPER
 SIZE A4
 FEED DIR LONG SIDE
 - *INIT STRING \0033&110\0033%0B
 - *TRAILER STRING \0033%A\0033&100
- SCREEN DUMP dialog:

SCREEN DUMP			
*DESTINATION	<input type="text" value="PRINTER/PLOTTER"/>		
*OUTPUT REGION			
UPPER LEFT	<input type="text" value="X 5%"/>	<input type="text" value="Y 0%"/>	
LOWER RIGHT	<input type="text" value="X 100%"/>	<input type="text" value="Y 100%"/>	
			*LANGUAGE
			<input type="text" value="HP-GL"/>

Output Example



Print/Plot Function
Output Examples

Setup Data List Output

This an example of the CHANNEL DEFINITION screen in the PCL format.

Setup

- Screen: CHANNELS: CHANNEL DEFINITION
- USER COMMENT on the Screen:
ID-VG CHARACTERISTICS
- SYSTEM: PRINT/PLOT SETUP screen:
 - *FORM FEED ENABLE
 - *COLOR/B/W B/W
 - *LINE 60
 - *PAPER SIZE A4
 - FEED DIR SHORT SIDE
 - *OUTPUT ITEM ENABLE for all
- PRINT/PLOT SETUP DATA dialog:

PRINT/PLOT SETUP DATA			
*DESTINATION	<input type="text" value="PRINTER/PLOTTER"/>		
*OUTPUT REGION			
UPPER LEFT	<input type="text" value="X"/> <input type="text" value="5%"/>	<input type="text" value="Y"/> <input type="text" value="0%"/>	*OUTPUT PAGE <input type="text" value="CURRENT"/>
*PRINT/PLOT COMMENT	*LANGUAGE <input type="text" value="PCL"/>	*RESOLUTION <input type="text" value="75 DPI"/>	
<input type="text" value="SAMPLE DEVICE 1"/>			

Print/Plot Function
Output Examples

Output Example

*** Agilent 4156B SETUP DATA *** Dec 1 20:00:00 1999 PAGE 1

ID-VG CHARACTERISTICS
SAMPLE DEVICE1

CHANNELS: CHANNEL DEFINITION

*MEASUREMENT MODE SWEEP

*CHANNELS

MEASURE	UNIT	VNAME	INAME	MODE	FCTN	STBY	SERIES RESISTANCE
SMU1:HR	VS	IS	COMMON	CONST			0 ohm
SMU2:HR	VG	IG	V	VAR1			0 ohm
SMU3:HR	VD	ID	.V	CONST			
SMU4:HR	VSB	ISB	V	VAR2			
VSU1		-----					
VSU2		-----					
VMU1		-----			----	----	
VMU2		-----			----	----	

Print/Plot Function
Output Examples

Measurement Result List Output

This is an example of the measurement result list using the PCL format.

Setup

- Screen: GRAPH/LIST: LIST
- USER COMMENT on the Screen:
ID-VG CHARACTERISTICS
- SYSTEM: PRINT/PLOT SETUP screen:
 - *FORM FEED ENABLE
 - *COLOR/B/W B/W
 - *LINE 60
 - *PAPER
 SIZE A4
 - FEED DIR SHORT SIDE
 - *OUTPUT ITEM ENABLE for all
- PRINT/PLOT DATA LIST dialog:

PRINT/PLOT DATA LIST			
*DESTINATION	PRINTER/PLOTTER		
*OUTPUT REGION	*OUTPUT DATA (INDEX NO)		
UPPER LEFT	X 5%	Y 0%	1 <--> 65
*PRINT/PLOT COMMENT	*LANGUAGE	*RESOLUTION	
SAMPLE DEVICE 1	PCL	75 DPI	

Output Example

- First sheet:

*** Agilent 4156B DATA LIST *** Dec 1 20:00:00 1999 PAGE 1

ID-VG CHARACTERISTICS
SAMPLE DEVICE1

VG = -1.000 V to 4.000 V in 50mV step
VSB = 0.0000 V to -2.0000 V in -500.0mV step

NO.	VG (V)	ID (A)
1	-1.000 V	10.89pA
2	-950mV	11.01pA
:	:	:
:	:	:
:	:	:
49	1.400 V	2.44708mA

- Second sheet:

*** Agilent 4156B DATA LIST *** Dec 1 20:00:00 1999 PAGE 2

ID-VG CHARACTERISTICS
SAMPLE DEVICE1

NO.	VG (V)	ID (A)
50	1.450 V	2.75585mA
51	1.500mV	3.07660mA
:	:	:
:	:	:
:	:	:
65	2.200 V	8.27044mA

- Last sheet:

*** Agilent 4156B DATA LIST *** Dec 1 20:00:00 1999 PAGE 3

ID-VG CHARACTERISTICS
SAMPLE DEVICE1

MARKER POSITION : DATA# 1 [1/1]

Print/Plot Function
Output Examples

Measurement Result Graph Output

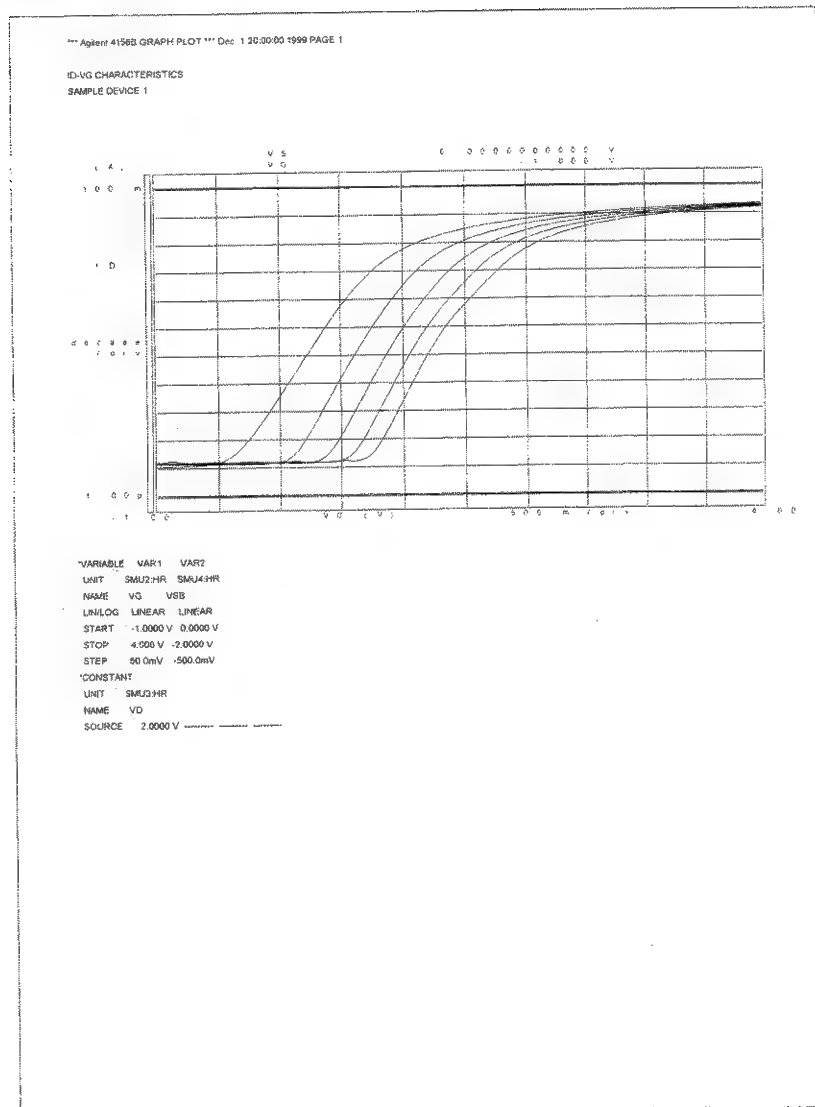
This is an example of a measurement result graph in HP-GL format, using an HP LaserJet printer in portrait mode.

Setup

- Screen: GRAPH/LIST: GRAPHICS
- USER COMMENT on the Screen:
ID-VG CHARACTERISTICS
- SYSTEM: PRINT/PLOT SETUP screen:
 - *FORM FEED ENABLE
 - *COLOR/B/W B/W
 - *LINE 60
 - *COLUMN 80
 - *PAPER
 SIZE A4
 FEED DIR SHORT SIDE
 - *OUTPUT ITEM ENABLE for all
 - *INIT STRING \0033%0B
 - *TRAILER STRING \0033%A
- GRAPH PLOT dialog:

GRAPH PLOT				
*DESTINATION	PRINTER/PLOTTER			
*OUTPUT REGION			*GRAPH TRACE ONLY	NO
UPPER LEFT	X 5%	Y 0%	*PRINT SETUP DATA	YES
LOWER RIGHT	X 100%	Y 100%	POSITION	BOTTOM
			*LANGUAGE	
*PRINT/PLOT COMMENT			HP-GL	
SAMPLE DEVICE 1				

Output Example



NOTE

PCL Mode Output

If you select the PCL mode, the font size of the header line, comment and setup data depends on the printer.

Print/Plot Function
Output Examples

System Page Organization

This chapter introduces Agilent 4155B/4156B screen groups, and describes the SYSTEM screen group. For descriptions of the other screen groups, see the *4155B/4156B User's Guide: Measurement and Analysis*.

This chapter contains the following sections:

- “Screen Structure”
- “SYSTEM Screen Group”
- “SYSTEM: FILER screen”
- “SYSTEM: MISCELLANEOUS screen”
- “SYSTEM: CONFIGURATION screen”
- “SYSTEM: SELF-CALIBRATION/DIAGNOSTICS screen”
- “SYSTEM: PRINT/PLOT SETUP screen”
- “SYSTEM: COLOR SETUP screen”
- “Screen Operation”
- “Status Indicators”

Screen Structure

The 4155B/4156B has seven screen groups, as shown in the following table.

Screen Group	Display Screen
Channels	CHANNELS: CHANNEL DEFINITION
	CHANNELS: USER FUNCTION DEFINITION
	CHANNELS: USER VARIABLE DEFINITION
Measure	MEASURE: SWEEP SETUP
	MEASURE: SAMPLING SETUP
	MEASURE: PGU SETUP
	MEASURE: MEASURE SETUP
	MEASURE: OUTPUT SEQUENCE
Display	DISPLAY: DISPLAY SETUP
	DISPLAY: ANALYSIS SETUP
Graph/List	GRAPH/LIST: GRAPHICS
	GRAPH/LIST: LIST
Stress	STRESS: CHANNEL DEFINITION
	STRESS: STRESS SETUP
	STRESS: STRESS FORCE
System	SYSTEM: FILER
	SYSTEM: MISCELLANEOUS
	SYSTEM: CONFIGURATION
	SYSTEM: SELF-CALIBRATION/DIAGNOSTICS
	SYSTEM: PRINT/PLOT SETUP
	SYSTEM: COLOR SETUP
Knob Sweep	KNOB SWEEP

System Page Organization Screen Structure

CHANNELS screen group	Defines the measurement modes, measurement channels, and user functions.
MEASURE screen group	Sets the measurement parameters.
DISPLAY screen group	Sets up the display of measurement results.
GRAPH/LIST screen group	Displays the measurement results.
STRESS screen group	Sets and monitors the stress force.
SYSTEM screen group	Controls mass storage, sets system parameters for the 4155B/4156B, sets the print/plot parameters, and so on.
KNOB SWEEP screen group	Displays the measurement results when the knob sweep function is used.

You can use the front-panel keys in the PAGE CONTROL key group to display the desired screen. The PAGE CONTROL key group has the following keys:

Chan	Displays the CHANNELS screen group.
Meas	Displays the MEASURE screen group.
Disp	Displays the DISPLAY screen group.
Graph/List	Displays the GRAPH/LIST screen group.
Stress	Displays the STRESS screen group.
System	Displays the SYSTEM screen group.

To display the KNOB SWEEP screen, press:

1. the front-panel green key
2. Single key

For details about the KNOB SWEEP screen, see Chapter 3 of the *4145B/4156B User's Guide: Measurement and Analysis*.

SYSTEM Screen Group

The SYSTEM screen group contains the following screens:

Filer	Executes the file operations (such as saving and getting files) on a diskette, in the internal memory, or on a network file system. This screen is displayed by pressing System key, or by selecting FILER softkey on a SYSTEM sub-screen.
Miscellaneous	Miscellaneous system settings, such as GPIB addresses, the built-in clock, and network setup. This screen is displayed by selecting MISCELLANEOUS softkey on a SYSTEM sub-screen.
Configuration	Displays the software revision and units configuration. This screen is displayed by selecting CONFIG softkey on a SYSTEM sub-screen.
Self-Calibration/ Diagnostics	Executes calibration and diagnostics. This screen is displayed by selecting CALIB/DIAG softkey on a SYSTEM sub-screen.
Print/Plot setup	Sets the print/plot parameters. This screen is displayed by selecting PRINT SETUP softkey on a SYSTEM sub-screen.
Color setup	Sets the screen colors. This screen is displayed by selecting COLOR SETUP softkey on a SYSTEM sub-screen.

To move to the SYSTEM screen group, press System key.

To start the save and get functions of the filer (SYSTEM: FILER) screen, press Save key or Get key.

SYSTEM: FILER screen

On the "SYSTEM: FILER" screen, you can execute file operations from a diskette, internal memory, or the network file system.

The 4155B/4156B filer *cannot* operate on files that are created by another system. However, if the files satisfy the file name restrictions of the 4155B/4156B file system, you can use the following functions:

- purge
- rename
- copy from one diskette to another diskette

DISK

The DISK field specifies the mass storage device for the file operation. Choose the device by selecting one of the following:

FLOPPY	Specifies a diskette inserted in the built-in flexible disk drive.
drive name	<p>The softkey label is not "drive name", but the strings entered into the LABEL field of the NETWORK DRIVE SETUP table on the SYSTEM:MISCELLANEOUS screen. See "NETWORK DRIVE SETUP" on page 5-27.</p> <p>When this softkey is selected, the 4155B/4156B mounts a directory on the NFS server, and displays a file catalog in the FILE CATALOG area. The directory is specified by the DIRECTORY field of the NETWORK DRIVE SETUP table. The name will be displayed in the area next to the DISK field.</p> <p>Before selecting this softkey, confirm that the NFS server has already exported the directory for the 4155B/4156B.</p> <p>To unmount the network file system, select the FLOPPY softkey, or turn off the 4155B/4156B.</p>

FILE CATALOG

The FILE CATALOG field displays the file catalog (a maximum of 199 files) of the diskette or the network file system, and shows the following file information:

FORMAT	DOS or HP LIF format (diskette only).
VOLUME	The volume name (diskette only).
USED	The disk space occupied by the files (diskette only).
AVAIL	The free disk space for data storage (diskette only).
DIR	The name of the directory mounted by the 4155B/4156B (NFS only).
FILE NAME	The file name used to identify the data.
SIZE	The file size (in bytes for DOS, in blocks for HP LIF).
DATE and TIME	The date and time when the file was created or last modified.
COMMENT	An optional comment, up to 16 characters long.

To scroll the catalog, use the rotary knob, or press the up or down arrow key.

When using the SAVE, GET, PURGE, RENAME, or COPY functions, you can specify a file name from the FILE CATALOG area. Move the pointer to the desired filename using the rotary knob or arrow keys, then press SELECT softkey.

To search for a specific file name, press the alphanumeric key for the first character of the file name. The field pointer moves to the first file name that starts with the character selected.

File Type

The following are file types (file suffixes) used by the 4155B/4156B:

MES	Measurement setup data file
STR	Stress setup data file
DAT	Measurement setup and result data file
CST	Customized file (consists of settings from the SYSTEM screen group and the ASCII SAVE window)
PRO	4145B setup data file
PCL	Hard copy file for PCL format
PGL	Hard copy file for HP-GL format
TIF	Hard copy file for TIFF format
TXT	Measurement result data file for spreadsheets

System Page Organization

SYSTEM: FILER screen

FUNCTION

The FUNCTION field specifies the file operation. When the field pointer is on this field, the following softkeys, shown in Menu 1 and Menu 2, are available.

Menu 1:

FILE CATALOG	Reads and displays the file catalog. A maximum of 199 files can be listed. This softkey also changes the secondary softkeys to those shown in Menu 2.
SAVE	Saves the specified file.
GET	Gets the specified file.
PURGE	Purges the specified file/directory.
RENAME	Renames the specified file.
COPY	Copies the specified file.
MAKE DIRECTORY	Creates a new directory under the directory mounted by the 4155B/4156B (NFS only).
DISK OPERATION	Opens the Disk Operation screen used to initialize or copy the diskette (diskette only).

Menu 2:

FILE CATALOG	Reads and displays the file catalog. A maximum of 199 files can be listed.
EXIT FILE CATALOG	Changes the secondary softkeys to those shown in Menu 1.
CHANGE DIR	Changes the current directory to the directory specified by the pointer (NFS only).
UPPER DIR	Changes the current directory to one level higher than the current directory (NFS only).
ROOT DIR	Changes the current directory to the root directory. The root directory is always the directory specified by the NETWORK DRIVE SETUP table on the MISCELLANEOUS screen (NFS only).
READ COMMENT	Reads the COMMENT field for the specified file (diskette only).
READ COMMENT ALL	Reads the COMMENT field for all files on the diskette (diskette only).

SAVE Softkey

To start the save function, press the SAVE softkey or the Save key. Either key displays the following entry box and softkeys.

- Entry box:

FUNCTION: SAVE			
NAME			
TYPE		COMMENT	

- Softkeys:

EXECUTE	Saves the data.
EXIT	Exits the SAVE function.

TYPE field

The TYPE field specifies the data type. In this field, select:

MES	Specifies the measurement setup data.
STR	Specifies the stress setup data.
DAT	Specifies the measurement setup and result data.
CST	Specifies the customized system data. This softkey is <i>not</i> available for internal memory (MEM*).

For internal memory (MEM*), the first character of the TYPE (M, S or D) will be displayed in the upper-right corner of the MEM* softkey.

COMMENT field

The COMMENT field is used to enter file comments, which will be displayed in the FILE CATALOG area. A maximum of 16 characters are allowed.

For internal memory (MEM*), the comments are displayed on the MEM* softkey. A maximum of 14 characters are allowed.

System Page Organization
SYSTEM: FILER screen

NAME field

The NAME field specifies the file name of data to be saved. The file name must be:

- 6 characters (maximum) for HP LIF format. Do not use "_" as the last character of the filename.
- 8 characters (maximum) for DOS format.
- 36 characters (maximum) for a network file system, and 58 characters (maximum) including the directory path.

When the pointer is in the NAME field, the softkeys shown in Menu 1 and Menu 2 are available.

- Menu 1:

FILE

CATALOG

Reads and displays the file catalog. A maximum of 199 files can be listed. This softkey also changes the secondary softkeys to those shown in Menu 2.

MEM*

Selects the internal memory MEM1, MEM2, MEM3, or MEM4 for saving data.

- Menu 2:

FILE

CATALOG

Reads and displays the file catalog. A maximum of 199 files can be listed.

EXIT FILE

CATALOG

Changes the secondary softkeys to those shown in Menu 1.

SELECT

Selects a file name from the FILE CATALOG area. Used to update data in an existing file. The file name (NAME, TYPE and COMMENT) is specified by the pointer in the FILE CATALOG area.

Setup items that are saved to the customize (CST) file

The following setup items are stored when you set CST in the TYPE field.

- SYSTEM: PRINT/PLOT SETUP screen
 - DESTINATION
 - LANGUAGE
 - FORM FEED
 - COLOR/ B/W
 - LINE
 - COLUMN
 - RESOLUTION
 - PAPER
 - OUTPUT ITEM
 - INIT STRING
 - TRAILER STRING
- SYSTEM: COLOR SETUP screen
 - HUE
 - SATURATION
 - LUMINOSITY
 - PLOTTER PEN NO.
 - BRIGHTNESS
- SYSTEM: MISCELLANEOUS screen
 - REMOTE CONTROL
 - BEEP
 - NETWORK PRINTER SETUP
 - NETWORK DRIVE SETUP
- ASCII SAVE WINDOW
 - UNIT
 - DELIMITER
 - STRING MARK
- hard copy setup window
 - DESTINATION
 - FILE NAME
 - OUTPUT REGION
 - PRINT/PLOT COMMENT
 - OUTPUT PAGE
 - GRAPH TRACE ONLY
 - OUTPUT DATA
 - PRINT SETUP DATA
- INIT file start screen displayed after getting the INIT file

System Page Organization
SYSTEM: FILER screen

GET Softkey

To start the get function, press the GET softkey or the Get key. Either key will display the following entry box and primary softkeys.

- Entry box:

FUNCTION: GET	
NAME	<input type="text"/>
TYPE	<input type="text"/>

- Softkeys:

EXECUTE	Gets (retrieves) the specified data.
EXIT	Exits the GET function.

TYPE field

The TYPE field specifies the data type. In this field, select:

MES	Specifies the measurement setup data.
STR	Specifies the stress setup data.
DAT	Specifies the measurement setup and result data.
CST	Specifies the customized system data.
PRO	Specifies the 4145B setup data.

NOTE

Number of Sweep Steps

The 4155B/4156B can also read the DAT file saved by the 4145B. When the 4155B/4156B reads the 4145B data file, if the number of primary sweep steps is more than 1001, the 4155B/4156B sets the number of sweep steps to 1001, and discards the corresponding measurement results.

NAME field

The NAME field specifies the file name to get. When the pointer is in this field, the softkeys shown in Menu 1 and Menu 2 are available.

- Menu 1:

**FILE
CATALOG**

Reads and displays the file catalog. A maximum of 199 files can be listed. This softkey also changes the softkeys to those shown in Menu 2.

MEM*

Selects the internal memory MEM1, MEM2, MEM3, or MEM4 for getting data.

On the softkey label, a notation in the upper-right corner shows the data type:

M: MES data or PRO data

S: STR data

D: DAT data

- Menu 2:

**FILE
CATALOG**

Reads and displays the file catalog. A maximum of 199 files can be listed.

**EXIT FILE
CATALOG**

Changes the secondary softkeys to those shown in Menu 1.

SELECT

Selects the file to get. The file is specified by the pointer in the FILE CATALOG area.

System Page Organization
SYSTEM: FILER screen

PURGE Softkey

To start the purge function, press PURGE. The following entry box and softkeys are displayed.

- Entry box:

FUNCTION: PURGE	
NAME	<input type="text"/>
TYPE	<input type="text"/>

- Softkeys:

EXECUTE	Purges (deletes) the specified data.
EXIT	Exits the PURGE function.

TYPE field

The TYPE field specifies the data type. In this field, select:

*	Specifies all types of data.
MES	Specifies the measurement setup data.
STR	Specifies the stress setup data.
DAT	Specifies the measurement setup and result data.
CST	Specifies the customized system data.
PRO	Specifies the 4145B setup data.

NAME field

The NAME field specifies the file name or directory name to purge (delete). The directory to be purged must be empty. When the pointer is in this field, the softkeys shown in Menu 1 and Menu 2 are available.

- Menu 1:

**FILE
CATALOG**

Reads and displays the file catalog. A maximum of 199 files can be listed. This softkey also changes the secondary softkeys to those shown in Menu 2.

MEM*

Selects the internal memory MEM1, MEM2, MEM3, or MEM4 for deleting data.

On the softkey label, a notation in the upper-right corner shows the data type:

M: MES data or PRO data

S: STR data

D: DAT data

- Menu 2:

**FILE
CATALOG**

Reads and displays the file catalog. A maximum of 199 files can be listed.

**EXIT FILE
CATALOG**

Changes the secondary softkeys to those shown in Menu 1.

SELECT

Selects the file or directory to be purged. The file or directory is specified by the pointer in the FILE CATALOG area.

System Page Organization

SYSTEM: FILER screen

RENAME Softkey

This function is available for a file on the diskette or on the network file system mounted by the 4155B/4156B. This function is *not* available for the directory on the network file system.

The following entry box and primary softkeys are displayed.

- Entry box:

FUNCTION: RENAME	
NAME	<input type="text"/>
TYPE	<input type="text"/>
NEW NAME	<input type="text"/>

- Softkeys:

EXECUTE	Renames the file.
EXIT	Exits the RENAME function.

TYPE field

The TYPE field specifies the data type. In this field, select:

MES	Specifies the measurement setup data.
STR	Specifies the stress setup data.
DAT	Specifies the measurement setup and result data.
CST	Specifies the customized system data.
PRO	Specifies the 4145B setup data.

NAME field

The NAME field specifies the file to rename. The NEW NAME field specifies a new file name. The file name must be:

- 6 characters (maximum) for HP LIF format. Do not use "_" as the last character of the filename.
- 8 characters (maximum) for DOS format.
- 36 characters (maximum) to store on a network file system, and a total of 58 characters including the directory path.

System Page Organization
SYSTEM: FILER screen

When the pointer is in the NAME field, the softkeys shown in Menu 1 and Menu 2 are available.

- Menu 1:

FILE CATALOG	Reads and displays the file catalog. A maximum of 199 files can be listed. This softkey also changes the secondary softkeys to those shown in Menu 2.
-------------------------	---

- Menu 2:

FILE CATALOG	Reads and displays the file catalog. A maximum of 199 files can be listed.
-------------------------	--

EXIT FILE CATALOG	Changes the secondary softkeys to those shown in Menu 1.
------------------------------	--

SELECT SOURCE	Selects the file to be renamed. The file name (NAME and TYPE) is specified by the pointer in the FILE CATALOG area.
--------------------------	---

SELECT TARGET	Selects the new file name from the FILE CATALOG area. The file name (NEW NAME) is specified by the pointer in the FILE CATALOG area.
--------------------------	--

READ COMMENT	Reads the comments for the file specified by the pointer in the FILE CATALOG area (diskette only).
-------------------------	--

READ COMMENT ALL	Reads the comments for all files listed in the FILE CATALOG area (diskette only).
---------------------------------	---

System Page Organization

SYSTEM: FILER screen

COPY Softkey

This function is used to copy files between a diskette and internal memory, between two diskettes, within a diskette, within the network file system the 4155B/4156B mounts, or between the network file system and internal memory.

The following entry box and primary softkeys will be displayed.

- Entry box:

FUNCTION: COPY	
SOURCE NAME	
TYPE	
TARGET NAME	

	TARGET DISK

- Softkeys:

EXECUTE	Copies the data.
EXIT	Exits the COPY function.

TYPE field

The TYPE field specifies the data type. In this field, select:

*	Specifies all types of data.
MES	Specifies the measurement setup data.
STR	Specifies the stress setup data.
DAT	Specifies the measurement setup and result data.
CST	Specifies the customized system data.
PRO	Specifies the 4145B setup data.

TARGET DISK field

The TARGET DISK field specifies whether the source and target files are on the same diskette or different diskettes. The following secondary softkeys are available:

SAME	The target file is on the same diskette as the source file.
OTHER	The target file is on a different diskette than the source file.

SOURCE NAME field and TARGET NAME field

The SOURCE NAME field specifies the file name to be copied. The TARGET NAME field specifies the new name for the file.

The file name must be:

- 6 characters (maximum) for HP LIF format. Do not use "_" as the last character of the filename.
- 8 characters (maximum) for DOS format.
- 36 characters (maximum) to store on a network file system, and a total of 58 characters including the directory path.

When the pointer is in this field, the softkeys shown in Menu 1 and Menu 2 are available.

• Menu 1:

FILE CATALOG	Reads and displays the file catalog. A maximum of 199 files can be listed. This softkey also changes the secondary softkeys to those shown in Menu 2.
MEM*	Specifies data in internal memory MEM1, MEM2, MEM3, or MEM4.

• Menu 2:

FILE CATALOG	Reads and displays the file catalog. A maximum of 199 files can be listed.
EXIT FILE CATALOG	Changes the secondary softkeys to those shown in Menu 1.
SELECT SOURCE	Selects the file to be copied. The file name (SOURCE NAME and TYPE) is specified by the pointer in the FILE CATALOG area.
SELECT TARGET	Selects the new file name from the FILE CATALOG area. The file name (TARGET NAME) is specified by the pointer in the FILE CATALOG area.
READ COMMENT	Reads the comment for the file specified by the pointer on the FILE CATALOG area (diskette only).
READ COMMENT ALL	Reads the comments for all files listed in the FILE CATALOG area (diskette only).

System Page Organization
SYSTEM: FILER screen

MAKE DIRECTORY Softkey

This function creates a subdirectory on the NFS server. The subdirectory will be under the directory mounted by the 4155B/4156B.

The following entry box and primary softkeys will be displayed.

- Entry box:

FUNCTION:MAKE DIRECTORY	
NAME	<input type="text"/>

- Softkeys:

EXECUTE	Makes a directory with the specified name.
EXIT	Exits the MAKE DIRECTORY function.

NAME field

The NAME field specifies the new directory name.

The directory name can be up to 36 characters, and 58 characters when including the directory path.

When the pointer is in this field, the softkeys shown in Menu 1 and Menu 2 are available.

- Menu 1:

FILE CATALOG	Reads and displays the file catalog. A maximum of 199 files can be listed. This softkey also changes the secondary softkeys to those shown in Menu 2.
---------------------	---

- Menu 2:

FILE CATALOG	Reads and displays the file catalog. A maximum of 199 files can be listed.
EXIT FILE CATALOG	Changes the secondary softkeys to those shown in Menu 1.
SELECT	Selects the directory name. The directory is specified by the pointer in the FILE CATALOG area.

DISK OPERATION Softkey

This function allows you to initialize a diskette or to copy all the files on a diskette, and is available when the DISK field is set to FLOPPY DISK.

This softkey displays the disk operation function screen, which displays the following softkeys and fields.

EXECUTE	Executes the specified operation for the diskette.
EXIT	Exits the disk operation screen.

DISK OPERATION field

The DISK OPERATION field selects the desired operation by using the following secondary softkeys.

DISK INIT	Initializes the diskette. Initialization prepares the diskette so that the 4155B/4156B can use it for storing data.
DISK COPY	Copies the entire contents of one diskette to another. This is typically used to make a backup copy. The diskettes must have the same format and capacity.

FORMAT field

The FORMAT field (only for DISK INIT) selects the DOS or HP LIF format.

VOLUME LABEL field

The VOLUME LABEL field (only for DISK INIT) specifies a volume label for the diskette. The default volume name is "4155" or "4156". You *cannot* specify a blank label.

The volume name can be up to 8 characters for DOS format or up to 6 characters for HP LIF format.

PROGRESS STATUS field

The PROGRESS STATUS field displays the progress of the initialization or copy operation.

SYSTEM: MISCELLANEOUS screen

The SYSTEM: MISCELLANEOUS screen contains miscellaneous settings for the 4155B/4156B.

4155B is, 4156B is

This field specifies the GPIB operation mode for the 4155B/4156B. The following softkeys appear:

SYSTEM

CONTROLLER Sets the 4155B/4156B as the system controller. If you use IBASIC, select this softkey.

NOT SYSTEM

CONTROLLER Sets the 4155B/4156B for an external system controller.

GPIB ADDRESS

This field specifies the addresses of the 4155B/4156B and output device.

4155B/4156B Enter the GPIB address of the 4155B/4156B.

HARD COPY Enter the GPIB address of the printer or plotter connected to the 4155B/4156B.

REMOTE CONTROL

This table specifies the remote control command set as follows. DELIMITER and EOI entry fields are available for the 4145 command set.

COMMAND SET Select the 4155/4156 or 4145 command set.

DELIMITER Select a comma or a carriage return and line feed (CR/LF).

EOI Set EOI on or off.

NOTE

Changing the COMMAND SET Field

If you change the COMMAND SET field, the 4155B/4156B will be reset, and setup data will be lost.

CLOCK

This table sets the present date and time. Change the date and time by using the number keys, or UP/DOWN softkeys. Then press SET softkey to apply the change.

POWER LINE FREQUENCY

This field sets the power line frequency. The selectable frequency is 50 or 60 Hz.

SYSTEM SETUP

This table specifies the following parameters.

BEEP	This field sets the beep sound ON or OFF.
SCREEN SAVE	<p>This field sets the time interval before the screen saver works (screen does not display anything). The time interval can be 0 to 60 minutes. To release the screen saver, touch any key or the rotary knob.</p> <p>To disable the screen saver, enter 0 (zero).</p>
LP TIMEOUT	<p>This field sets the maximum time to confirm the connection with the printer server defined in the NETWORK PRINTER SETUP table. The 4155B/4156B waits for the response from the printer server when a hard copy is requested. If the 4155B/4156B does not receive a response within the time specified by this setting, a time-out error will occur.</p> <p>The time-out can be set from 1 to 32767 seconds. The default setting is 300 seconds.</p>

System Page Organization
SYSTEM: MISCELLANEOUS screen

NETWORK SETUP

This table specifies the network setup parameters. If you connect the 4155B/4156B to your local network, you must complete this table.

The 4155B/4156B stores the setup in its internal memory and keeps the setup data until you change it, even if you turn off the unit.

NOTE

Network Function

The 4155B/4156B can be an NFS client, and can use a remote printer to make hard copies. This allows you to access a file on a network file system on your NFS server, and to make hard copies using the remote printer via your printer server.

- To use the 4155B/4156B as an NFS client:
 1. Fill in the NETWORK SETUP table.
 2. Fill in the NETWORK DRIVE SETUP table.
 3. Access the file using the SYSTEM: FILER screen.
- To use a remote printer:
 1. Fill in the NETWORK SETUP table.
 2. Fill in the NETWORK PRINTER SETUP table.
 3. Fill in the SYSTEM: PRINT/PLOT SETUP screen.
 4. Make hard copies using the PRINT/PLOT dialog box.

NOTE

Network Setup

If you are uncertain as to your local network configuration, or have questions concerning the network setup parameters, contact your network system administrator.

System Page Organization
SYSTEM: MISCELLANEOUS screen

Entry fields

HOST NAME	The host name of the 4155B/4156B. A maximum of 15 characters is allowed.
IP ADDRESS	The IP address of the 4155B/4156B. The default setting is '0.0.0.0', which is an invalid number for the IP ADDRESS.
USER ID	Your user ID. This must be a positive integer, 0 (zero) is not allowed. The default setting is 200.
GROUP ID	Your group ID. The default setting is 100.

Softkeys

After you enter the HOST NAME, the 4155B/4156B displays two secondary softkeys for the HOST NAME field:

DISABLE	Disables the network function.
[]	Enables the network function and calls the setup in memory. This softkey will be labeled with the HOST NAME you entered. For example, if you entered 'analyzer1' into the HOST NAME field, a softkey labeled analyzer1 will be displayed.

NETWORK PRINTER SETUP

This table specifies the setup parameters for a printer server and a printer connected to the server. After filling in this table, the setup must be stored in the internal memory. To store the setup in memory, press ADD softkey. The 4155B/4156B will use this printer as the remote printer.

The 4155B/4156B can store a maximum of four setups, and keeps the setup data until you update or delete the setup, even if the unit has been turned off.

PRINTER	The printer name assigned to the remote printer, and defined on the printer server. A maximum of 15 characters is allowed.
IP ADDRESS	The IP address assigned to the printer server. The default setting is '0.0.0.0', which is an invalid number for the IP ADDRESS.
TEXT OUT	<p>The text output option of the lpr command. The default setting is '-h'.</p> <p>For BSD servers, this parameter must be entered as '<i>-option</i>', where <i>option</i> indicates the filtering option.</p> <p>For SystemV servers, this parameter must be entered as '<i>-option</i>', where <i>option</i> indicates the printer option.</p> <p>For more information regarding <i>option</i>, see the network operating and service manual.</p>
GRAPH OUT	<p>The graphics output option of the lpr command. The default setting is '-h -l'.</p> <p>See TEXT OUT for more information.</p>
SERVER TYPE	The server type, BSD or SystemV. The default setting is BSD.

The NETWORK PRINTER SETUP table has the following softkeys available:

ADD	Adds the printer setup information to the internal memory. A softkey will be created and labeled with the printer name. For example, if you enter 'printer1', and then press ADD softkey, a printer1 softkey will be created. This key is used to call the setup table.
DELETE	Deletes the setup (on the screen and in the internal memory) specified by the PRINTER field.
UPDATE	Updates the setup data to the internal memory. The setup data currently in memory is replaced by the new information in the NETWORK PRINTER SETUP table.

NETWORK DRIVE SETUP

This setup table specifies the IP address of the NFS server and the directory mounted by the 4155B/4156B. After filling in this table, the setup must be stored in the internal memory, by selecting ADD softkey.

The 4155B/4156B can store a maximum of four setups, and keeps the data until you update or delete the setup, even if the unit is turned off.

LABEL	The label or name of the setup information in the NETWORK DRIVE SETUP table. A maximum 15 characters is allowed.
IP ADDRESS	The IP address of the NFS server. The default setting is '0.0.0.0', which is an invalid number for the IP ADDRESS.
DIRECTORY	The name of the directory mounted by the 4155B/4156B. A maximum of 58 characters are allowed. The default setting is '/' (the root directory). The 4155B/4156B mounts this directory and uses it as the root directory. Confirm that the NFS server has exported the directory to the 4155B/4156B.

The NETWORK DRIVE SETUP table has the following softkeys:

ADD	Adds the setup to the internal memory. After completing this table, press ADD softkey to register the information to the internal memory. A softkey will be created and labeled. For example, if you enter 'mydir1' into the LABEL field, and then press ADD softkey, the mydir1 softkey will have been created. This softkey is used to call the NETWORK DRIVE SETUP.
DELETE	Deletes the setup on the screen from the internal memory.
UPDATE	Updates the setup data in the internal memory. The setup data currently in memory is replaced by the new information in the NETWORK DRIVE SETUP table.

SYSTEM: CONFIGURATION screen

The SYSTEM: CONFIGURATION screen contains the system firmware revision and hardware configuration for the 4155B/4156B.

SOFTWARE REVISION

This table displays the following software revisions:

- host controller
- SMU controller
- A/D converter controller

CONFIGURATION

This table displays the hardware configuration for the 4155B/4156B.

SYSTEM: SELF-CALIBRATION/DIAGNOSTICS screen

The SYSTEM: SELF-CALIBRATION/DIAGNOSTICS screen is used to execute self-calibration and diagnostics.

While executing self-calibration or diagnostics, you *cannot* perform measurements.

CALIB/DIAG

This field allows you to choose self-calibration or diagnostics, by selecting CALIB or DIAG softkey.

The self-calibration tests are part of the MEAS UNIT diagnostics tests.

AUTO CALIB

This field determines if self-calibration will be executed automatically, by selecting ON or OFF softkey.

If this field is set to ON, self-calibration is performed automatically every 30 minutes. Self-calibration is performed only when the 4155B/4156B state is idle. Automatic self-calibration will *not* execute when performing extended stress forcing or measurements, or when using the standby state.

CATEGORY

When CALIB softkey is selected in the CALIB/DIAG field, the CATEGORY field is automatically set to MEAS UNIT.

When DIAG softkey is selected in the CALIB/DIAG field, the following choices may be selected:

MEAS UNIT	Displays tests for measurement units.
LCD	Displays test items for the LCD.
CPU	Displays test items for the CPU.
I/O PERIPH	Displays tests for the I/O and peripherals.

System Page Organization

SYSTEM: SELF-CALIBRATION/DIAGNOSTICS screen

The columns in the table contain the following information.

STATUS

The STATUS column displays the following test results:

- Where the 4155B/4156B can detect whether the test passes or fails:

FAIL	Executed test failed.
PASS	Executed test passed.
blank	The test has not been performed.
- Where the 4155B/4156B cannot detect whether the test passes or fails:

DONE	Executed test is finished.
blank	Executed test is not finished.

ERROR

The ERROR column displays an error code if the executed test failed. Only the first error code is displayed in this field. To see if more errors have occurred, move the pointer to the test line. Up to seven error codes are displayed in the data entry field. For more information regarding error codes, see Chapter 10.

TARGET

The TARGET column displays the following information:

- test number

This number is used to execute the test by remote command. For more information, see Chapter 5 of the 4155B/4156B *SCPI Command Reference*.
- (SELF) or (INT.)

(SELF) is displayed if the test can be executed automatically.

(INT.) is displayed if the test must be executed interactively, that is, the operator must connect cables or make decisions during the test.
- test items

Name of the tests.

Executing the Tests

You can execute the tests as shown below:

1. Move the pointer to the desired test item.
2. Select the EXECUTE softkey.

If the pointer is at a (SELF) test, you can repeat the test continuously by selecting REPEAT TEST softkey. You can stop executing the test by selecting STOP softkey. The REPEAT TEST softkey is available for the diagnostics, not for self-calibration.

If you want to execute all tests automatically, select:

- CALIB ALL softkey to execute all self-calibration tests.
- DIAG SELFTST ALL softkey to execute all tests displaying (SELF) in the TARGET field.

To stop executing tests, select STOP softkey.

Test Adapter

The following tests require the following test adapters.

Test Item	Adapter
Test No. 312 (LAN interface test)	LAN Test Adapter (Agilent Part Number 04155-61631)
Test No. 401 (parallel I/F test)	Parallel Test Adapter (Agilent Part Number 04155-61632)

SYSTEM: PRINT/PLOT SETUP screen

The SYSTEM: PRINT/PLOT SETUP screen is used to set the parameters of the printer or plotter. For more information regarding the print/plot functions, see Chapter 4.

DESTINATION

This field sets the interface used to connect your printer or plotter. The following parameters (softkeys) are available:

- | | |
|------------------------|---|
| PARALLEL | Selects the parallel interface. |
| GPIB | Selects the GPIB interface. The GPIB address is set on the SYSTEM: MISCELLANEOUS screen. |
| network printer | The softkey label is not “network printer”, but the strings entered into the PRINTER field of the NETWORK PRINTER SETUP table on the SYSTEM:MISCELLANEOUS screen. See “NETWORK PRINTER SETUP” on page 5-26.

This softkey selects a printer connected to your printer server. |

FORM FEED

This field is used to select whether the printer or plotter formfeeds a sheet of paper after printing.

- | | |
|----------------|---------------------------------|
| ENABLE | Enables the formfeed function. |
| DISABLE | Disables the formfeed function. |

LINE

The LINE field sets the number of lines on a page.

COLUMN

The COLUMN field sets the number of characters in a line.

COLOR/ B/W

This field sets the color, fixed color, or monochrome (black/white) mode.

COLOR	Sets the color mode. This mode is available only for HP-GL or PCL printers that have 16 color capability.
FIX CLR	Sets the fixed color mode. This mode is for HP-GL pen plotters and PCL color printers that have 8 color capability. The assignment of colors are defined by COLOR PEN NO. on the SYSTEM: COLOR SETUP screen. For more information, see "SYSTEM: COLOR SETUP screen" on page 5-36.
B/W	Sets the monochrome (black/white) mode.

PAPER

This table contains the paper settings, such as paper size, orientation, and so on. The paper settings consists of:

SIZE	<p>Sets the paper size. Available sizes are:</p> <ul style="list-style-type: none"> • CUSTOM • A3 (297 × 420 mm) • A4 (210 × 297 mm) • B4 (257 × 364 mm) • B5 (182 × 257 mm) • A (letter: 8.5 × 11 inch) • B (11 × 17 inch)
FEED DIR	<p>Sets the feed direction of the paper.</p> <ul style="list-style-type: none"> • SHORT SIDE: for portrait (width < length) • LONG SIDE: for landscape (width > length). <p>This is not available for the CUSTOM paper size setting.</p>
LENGTH	Sets the vertical length of the paper. This is available for the CUSTOM paper size setting only.
WIDTH	The horizontal width of the paper. This is available for the CUSTOM paper size setting only.
UNIT	The units for the paper size. Select either inch or millimeter.

System Page Organization
SYSTEM: PRINT/PLOT SETUP screen

OUTPUT ITEM

This table is used to select the items to be printed. For HP-GL, you can enable or disable all items. For PCL, the GRAPH items are always enabled.

TITLE	The title of the printout. This title is determined automatically according to the type of output information. <ul style="list-style-type: none">• *** Agilent 4156B SETUP DATA ***• *** Agilent 4156B DATA LIST ***• *** Agilent 4156B GRAPH PLOT ***
DATE&TIME	The current date and time from the built-in clock.
PAGE NO.	The page number of the printout.
USER COMMENT	The user-defined comments from the MEASURE or STRESS screens.
PRINT/PLOT COMMENT	The user-defined comments from the PRINT/PLOT SETUP DATA, PRINT/PLOT DATA LIST, or GRAPH PLOT screens.
GRAPH TRACE	The graphics plot curve from the GRAPH/LIST: GRAPH screen (for HP-GL, HR PCL, HR TIFF).
GRAPH FRAME & GRID	The frame and grid from the GRAPH/LIST: GRAPH screen (for HP-GL, HR PCL, HR TIFF).
GRAPH AXIS TEXT	The names, units, and scale of the graph axis (for HP-GL, HR PCL, HR TIFF).
GRAPH TEXT	The marker and cursor coordinate fields, data variables, and gradient and intercept line parameters (for HP-GL, HR PCL, HR TIFF).

In the above fields, the following softkeys are available:

ENABLE	Enables the item specified by the pointer.
DISABLE	Disables the item specified by the pointer.

INIT STRING / TRAILER STRING

To send an initialization command to the printer or plotter, enter the printer/plotter command in the INIT STRING field.

To send a command after printing or plotting is finished, enter the printer/plotter command in the TRAILER STRING field.

To enter commands, use the keyboard or ENTRY keys on the front panel. To enter an escape character (\0033), use ENTER ESCAPE CHAR softkey. For a list of available commands, see your printer/plotter user's manual.

Setup Examples:

- To print PCL data in landscape mode, enter the following commands:

```
*INIT STRING      \0033&l10\0033*r0F
*TRAILER STRING   \0033&l00
```

The INIT STRING sets the printer orientation to landscape and rotates the graphic images. The TRAILER STRING sets the orientation to portrait.

- To print HP-GL data in portrait mode, enter the following commands:

```
*INIT STRING      \0033%0B
*TRAILER STRING   \0033%A
```

The INIT STRING sets the printer to HP-GL/2 mode. The TRAILER STRING sets the printer to PCL5 mode.

- To print HP-GL data in landscape mode, enter the following commands:

```
*INIT STRING      \0033&l10\0033%0B
*TRAILER STRING   \0033%A\0033&l00
```

The INIT STRING sets the printer orientation to landscape and sets the printer to HP-GL/2 mode. The TRAILER STRING sets the printer to PCL5 mode and sets the printer orientation to portrait.

SYSTEM: COLOR SETUP screen

The SYSTEM: COLOR SETUP screen is used to set the screen colors, and to set colors for plotting or printing.

CATEGORY

The CATEGORY field lists the screen items for which you can specify color.

Background	Background color of the screen. If the Background and Graph Background are set to different colors, the graphic drawing speed will be slower.
Softkey Background	Softkey background color.
Active Background	Background color of a selected softkey or field.
Graph Background	Background color of a graph. If the Graph Background and Background are set to different colors, the graphic drawing speed will be slower.
Foreground	Color of the text (except titles and text related to Y1 and Y2 axes).
Active Foreground	Color of the text in a selected field.
Title	Color of the screen/table titles and the selected Y axis.
Frame	Color of the frames (table and graph plotting area).
Advisory	Background color of boxes that pop up (for example, to flag an incorrect setting).
Y1 Axis	Color of the Y1 axis text and curve.
Y2 Axis	Color of the Y2 axis text and curve.
Marker/Cursor/Line	Color of an inactive marker, cursor, or line.
Active Mkr/Csr/Lne	Color of an active marker, cursor, or line.
Overlay Plane	Color of an overlay plane.
Grid	Color of the grid.

HUE, SATURATION, LUMINOSITY

The HUE, SATURATION, and LUMINOSITY fields set the color value. You can specify a value from 0 to 1 in each field.

HUE	Pure color. As you change this value from 0 to 1, the color changes from red through orange, yellow, green, cyan (greenish blue), blue, magenta (purplish red), then back to red again (0 and 1 are both red).
SATURATION	Ratio of pure color to white, where 0 is no pure color (all white), and 1 is 100% pure color (no white). If this field is set to 0, the color is always white.
LUMINOSITY	Brightness, where 0 is no brightness, 1 is 100% brightness. If this field is set to 0, the color is always black.

To set a row to the desired color, select one of the following softkeys:

- **DEFAULT COLOR** sets all rows in the table to the default colors.
- **BLACK**
- **GREY**
- **WHITE**
- **RED**
- **ORANGE**
- **YELLOW**
- **GREEN**
- **CYAN** (greenish blue)
- **BLUE**
- **MAGENTA** (purplish red)

COLOR SAMPLE

This field displays the color the item will appear according to the selected HUE, SATURATION, and LUMINOSITY fields.

System Page Organization
SYSTEM: COLOR SETUP screen

PLOTTER PEN NO.

This field is used for fixed-color mode hard copies only. See the COLOR/ B/W field in "SYSTEM: PRINT/PLOT SETUP screen" on page 5-32.

- For an HP-GL pen plotter, this field specifies which pen the plotter uses to draw each screen item. The appropriate pens should be loaded in the pen carousel.
- For a color printer, this field specifies which color the printer uses to print each screen item. The values and corresponding colors available are:

1	Black
2	Red
3	Green
4	Yellow
5	Blue
6	Magenta
7	Cyan
8	White

BRIGHTNESS

This field is used for the brightness of the entire screen. You can specify a value from 0.15 to 1.

Screen Operation

This section explains how to fill in the entry fields on a screen, and the function of the blue, green and Edit front-panel keys.

Data Input or Edit

When you move the pointer to a field on a screen, you can fill in the field by entering characters or by selecting a softkey. The softkeys related to the field will appear when you move the pointer to that field.

There are several different methods for entering or editing data, depending on the type of entry field.

- For option fields

When the pointer is in an option field, the selectable input items for the field are displayed on softkeys. When a softkey is pressed, that item will appear in the appropriate field.

For example, when the pointer is in the "4155B is" (or "4156B is") field of the SYSTEM: MISCELLANEOUS screen, the following softkeys are available:

SYSTEM

CONTROLLER Enables the IBASIC capability.

NOT SYSTEM

CONTROLLER Disables the IBASIC capability.

- For comment and name fields

When the pointer is in a comment or name field, you can input characters using the ENTRY front-panel key group. The characters selected will appear in the data entry area, at the bottom of the screen.

For name fields, you can enter alphanumeric characters. For comment fields, you can also enter non-alphanumeric characters. You can enter upper or lowercase alphabet characters using the blue and green front-panel keys. You can enter special (non-alphanumeric) characters using the green front-panel key.

If a comment or name is already entered in the field, it also appears in the data entry area. You can edit it using the Edit front-panel keys.

After editing or entering the comment or name, press Enter key to put the name or comment in the field at the pointer location.

System Page Organization

Screen Operation

- For numeric data fields

When the pointer is in a numeric data field, enter the numeric data as follows:

1. Type the numeric value by pressing the numeric front-panel keys (the value appears in the data entry area). To place the value in the numeric data field at the pointer location, press Enter key.
2. Use the rotary knob to increase or decrease the value. Turn the knob clockwise to increase the value, or counterclockwise to decrease the value.

Blue front-panel key usage

The blue front-panel key has three states:

Non-shift state B, b, or G is not displayed in the lower-right corner of the screen. You can enter numeric values.

Uppercase shift state B is displayed in the lower-right corner of the screen. You can enter uppercase alphabet characters.

Lowercase shift state b is displayed in the lower-right corner of the screen. You can enter lowercase alphabet characters.

To change between these states:

- toggle between the non-shift/shift state by pressing the blue key.
- toggle between the upper/lowercase shift state by pressing the green key, then the blue key.

The following is a detailed description of changing between states:

Present Status	Desired Next Status	Key to be pressed
Non-shift	Uppercase blue-key shift	blue key
Uppercase blue-key shift	Non-shift	blue key
Non-shift	Lowercase blue-key shift	green, then blue key
Lowercase blue-key shift	Non-shift	blue key
Uppercase blue-key shift	Lowercase blue-key shift	green, then blue key
Lowercase blue-key shift	Uppercase blue-key shift	green, then blue key

Green front-panel key usage

You can use the green front-panel key to enter special (non-alphanumeric) characters, which are printed in green above the keys.

The green key action is momentary. That is, after you press the green key, only the next keystroke is effective. For example, to enter “# \$”, press the green key, 0, green key, and 1.

The green key mode has special functions for entering data, as shown in the following table.

Keys	Label	Function
Green, ⇐	⇐	Moves the cursor to the first column in the data entry area.
Green, ⇒	⇒	Moves the cursor to the last column of the present entry in the data entry area.
Green, Recall↓	Recall↑	Recalls the oldest input from the key buffer. The key buffer stores the 10 most recent entries in the data entry area.
Green, Clear	Clr→End	Clears the entered data from the present cursor position to the end.
Green, Enter	Calc	Calculates any expression entered in the data entry area.

The front-panel green key can also be used to perform dump (Plot/Print key), knob sweep (Single key), and zero offset cancel (Stop key) operations.

System Page Organization
Screen Operation

Edit front-panel keys

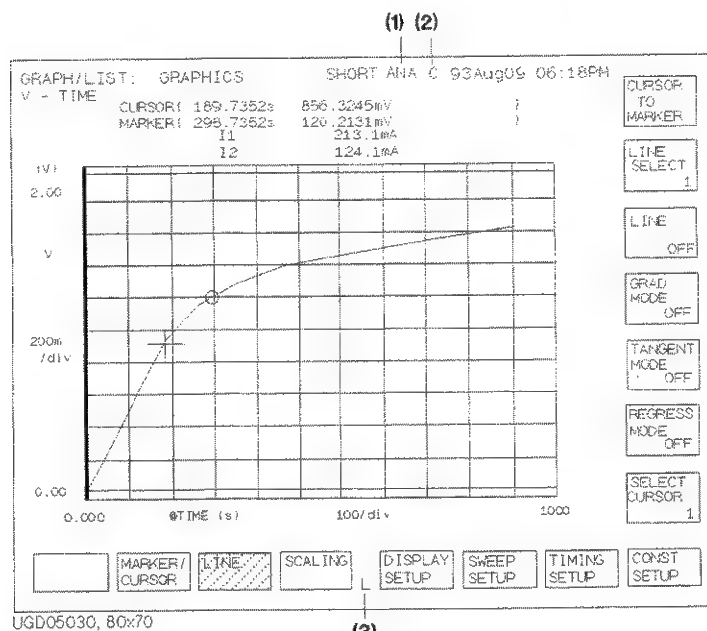
There are six keys in the Edit front-panel key group.

The following table shows the function of each key:

Key	Label	Functions
←		Moves the cursor left by one column in the data entry area.
⇒		Moves the cursor right by one column in the data entry area.
Delete		Deletes one character where the cursor is located.
Insert		Toggles the input mode in the data entry area between <i>insert</i> and <i>overtyping</i> modes.
Recall↓		Recalls the newest input from the key buffer.
Clear		Deletes all the characters in the data entry area.
Green, ←	←	Moves the cursor to the first column in the data entry area.
Green, ⇒	⇒	Moves the cursor to the last column of the present entry in the data entry area.
Green, Recall↓	Recall↑	Recalls the oldest input from the key buffer. The key buffer stores the 10 most recent entries in the data entry area.
Green, Clear	Clr→End	Clears the entered data from the present cursor position to the end.

Status Indicators

The status indicators indicate the present status of the 4155B/4156B. The display contains the following status indicators.



(1) indicates the following status:

TRG	Waiting for trigger input from an external instrument.
DRW	Drawing a measurement curve.
ANA	Performing auto-analysis or regression calculation.

(2) indicates the following status:

C	Performing auto-calibration.
Z	Performing an offset measurement for the zero offset cancel function.

(3) indicates the following status:

L	The screen is locked by an GPIB command.
---	--

System Page Organization
Status Indicators

External Keyboard

You can operate Agilent 4155B/4156B from an external keyboard instead of by pressing front-panel keys and softkeys. This chapter describes the correspondence between front-panel keys/softkeys and the external keyboard.

For functions of front-panel keys, refer to "Overview" in Chapter 1.

For correspondence when using the Instrument BASIC, refer to *Programmer's Guide*.

NOTE

The following functions are not available for the external keyboard:

- Keys not on the external keyboard

PAGE CONTROL key group:

- Chan
- Meas
- Display
- Graph/List
- Stress
- System

- Characters you cannot enter from the external keyboard

- Ω
- $^{\circ}$ (deg)

NOTE

When using an external keyboard, connect the external keyboard to the 4155B/4156B before applying power. If you connect the keyboard to the 4155B/4156B after applying power, the keyboard does not work.

External Keyboard

Front-Panel Keys		External Keyboard
softkeys	(from the left side)	
	primary softkey 1 to 8	F1 to F8
	(from the top)	
	secondary softkey 1 to 7	Shift+F1 to Shift+F7
MEASUREMENT key group	Single	Ctrl+S
	Repeat	Ctrl+R
	Append	Ctrl+A
	Stop	Ctrl+C
	Standby	Ctrl+Y
	Stress	Ctrl+T
	green key+ Single	Ctrl+N
	green key+ Stop	Ctrl+Z
Integ Time key group	Short	Ctrl+I
	Medium	Ctrl+J
	Long	Ctrl+K
IBASIC	Run	Ctrl+U or enter "RUN" in the data entry field on the IBASIC screen
	Pause	Ctrl+P or Pause
	Display	Ctrl+G or F9
arrow keys in the MARKER/CURSOR key group	←	←
	⇒	→
	↑	↑
	↓	↓
	Fast+ ←	Shift+ ←
	Fast+ ⇒	Shift+ →
	Fast+ ↑	Shift+ ↑
	Fast+ ↓	Shift+ ↓

External Keyboard

Front-Panel Keys		External Keyboard
rotary knob	clockwise	Alt+ →
	counterclockwise	Alt+ ←
	Fast+clockwise	Alt+Shift+ →
	Fast+counterclockwise	Alt+Shift+ ←
Print/Plot function	Plot/Print	Ctrl+D or Print Screen
	green key+Plot/Print	Shift+Print Screen
Help	Help	Ctrl+Shift+H
User File	Save	Ctrl+Shift+S
	Get	Ctrl+Shift+R
Edit key group	⇐	Ctrl+B, Shift+Tab, or Backspace
	green key+ ⇐	Ctrl+Shift+B, Ctrl+Shift+Tab, or Ctrl+Backspace
	⇒	Ctrl+F or Tab
	green key+ ⇒	Ctrl+Shift+F or Ctrl+Tab
	Delete	Delete or Alt+D
	Insert	Insert or Alt+I
	Recall↓	Ctrl+L
	green key+Recall↓	Ctrl+Shift+L
	Clear	Shift+F11 or Ctrl+Delete
	green key+Clear	F11
ENTRY key group	μ	u
	Exp	E
	Enter	Enter
	green key+Enter	Shift+Enter
	Space	space bar
	Other front-panel keys (except for Ω, ° (deg), blue key, and green key) correspond to same keys on the external keyboard.	

Initial Settings

This chapter explains the following:

- user-defined initial settings

Agilent 4155B/4156B can automatically get files from a diskette after applying power, and set the 4155B/4156B according to the files. This function saves you the trouble of getting application files every time you turn on the 4155B/4156B.

- default initial settings

If you turn on the 4155B/4156B without a diskette, the 4155B/4156B is set to the default initial settings. In this condition, internal memories contain measurement setup data for the most common applications.

User-Defined Initial Settings

If you turn on an 4155B/4156B with a diskette in the flexible disk drive, the 4155B/4156B automatically loads the following files from the diskette:

- files for setting setup and result screens

The fields of the setup and result screens are automatically set according to the files on the diskette. Also, you can specify which screen is displayed after turning on the 4155B/4156B.

- files for setting internal memories

If the diskette has files that can be loaded into the internal memories of the 4155B/4156B, the files are automatically loaded after turning on the 4155B/4156B.

- IBASIC programming file

If an IBASIC programming file with name "AUTOST" is on the diskette, this file is automatically loaded and started after loading the files for setting setup and result screens and internal memories. For details about "AUTOST" file, refer to the 4155B/4156B *Programmer's Guide*.

Files for setting setup and result screens

If the following files exist on diskette, the setup and result screens are automatically set up according to the files after you turn on the 4155B/4156B:

File Type	File Name
measurement setup file	INIT.MES
stress setup file	INIT.STR
measurement setup/result file	INIT.DAT
customize file	INIT.CST

The 4155B/4156B can get multiple INIT files. So, if INIT.CST, INIT.MES, and INIT.STR files exist on the diskette, all of them are loaded. However, the INIT.MES and INIT.DAT file both contain measurement setup data. So, if both these files exist on the diskette, the 4155B/4156B gets INIT.DAT, not INIT.MES.

Initial Settings
User-Defined Initial Settings

NOTE**Which Screen is Displayed after Getting Setup Files?**

If the INIT.MES or INIT.DAT file exists on the diskette, the screen that is displayed after getting the setup files is as follows.

- if file was created by SAVE

When you create INIT.MES or INIT.DAT file by using SAVE function on the SYSTEM: FILER screen, you can select one of the following screens to be displayed after getting the files:

- GRAPH/LIST: GRAPH screen
- GRAPH/LIST: LIST screen
- KNOB SWEEP screen
- CHANNELS: CHANNEL DEFINITION screen

- if file was created by RENAME or COPY

When you create INIT.MES or INIT.DAT file by using RENAME or COPY function on the SYSTEM: FILER screen, you cannot select which screen is displayed. The CHANNELS: CHANNEL DEFINITION screen is always displayed after getting the files.

Files for setting internal memories

If the following files exist on diskette, they are loaded automatically from diskette to internal memory after you turn on the 4155B/4156B:

- measurement setup files (MEM.MES)
- stress setup files (MEM.STR)
- measurement setup/result files (MEM.DAT)

Where MEM means MEM1, MEM2, MEM3, or MEM4, which correspond to the four internal memory areas. Only the above types of files can be loaded into internal memory.

If the same internal memory is specified by multiple files (for example, MEM1.MES, MEM1.DAT, and MEM1.STR), the priority is:

1. DAT
2. MES
3. STR

Default Initial Settings

When you turn on the 4155B/4156B without a diskette, the 4155B/4156B is set the default initial settings after finishing the power on test.

The default initial settings, except for system screen group, are also set by selecting DEFAULT MEASURE SETUP secondary softkey in the MEASUREMENT MODE field on the CHANNELS: CHANNEL DEFINITION screen. The default initial settings are as follows:

Measurement Units

Measurement units that are verified as operating normally are turned on and set to the idle state.

Setup items of setup and result screens

These items are set to the default initial settings whenever power is applied or *RST command is sent, except for the following items, which keep the same value that they had before *RST or before power was turned off.

- SYSTEM: MISCELLANEOUS screen
 - 4155 (or 4156) is System Controller or not
 - GPIB Address
 - Power Line Frequency
 - Screen Save
 - Network Setup
 - Network Printer Setup
 - Network Drive Setup
- SYSTEM: SELF-CALIBRATION/DIAGNOSTICS screen
- user comment field

The default initial settings for USER COMMENT fields of the MEASURE screen group and STRESS screen group are blank.

Initial Settings
Default Initial Settings

Internal memories

For the initial settings, internal memories contain the measurement setup data for the following basic applications.

- measurement setup data for bipolar transistor V_{ce} - I_c characteristics
- measurement setup data for FET (field effect transistor) V_{ds} - I_d characteristics
- measurement setup data for FET (field effect transistor) V_{gs} - I_d characteristics
- measurement setup data for diode V_f - I_f characteristics

You can select the secondary softkeys for the above applications when the pointer is in the MEASUREMENT MODE field on the CHANNELS: CHANNEL DEFINITION screen. The softkeys set the setup screens for the application, thus saving time.

Specifications

This chapter lists complete specifications and supplemental information of Agilent 4155B/4156B and Agilent 41501B. The specifications are the performance standards or limits against which the 4155B/4156B and 41501B are tested. When the 4155B/4156B and 41501B is shipped from the factory, it meets the specifications. The supplemental information are not specifications but are typical characteristics included as additional information for the operator.

Agilent 4155B/4156B functions:

- Set measurement and/or stress conditions
- Control measurement and/or stress execution
- Perform arithmetic calculations
- Display measured and calculated results on the LCD display
- Perform graphical analysis
- Store and recall measurement setups, and measurement and graphical display data
- Dump to printers or plotters for hardcopy output
- Perform measurement and analysis with internal Instrument BASIC
- Self-test, Auto-calibration

Agilent 4155B configuration:

- four medium power source monitor units (MPSMUs: 10 fA/2 μ V to 100 mA/100 V)
- two voltage source units (VSUs)
- two voltage monitor units (VMUs)

Agilent 4156B configuration:

- four high resolution source monitor units (HRSMUs: 1 fA/2 μ V to 100 mA/100 V)
- two voltage source units (VSUs)
- two voltage monitor units (VMUs)

Agilent 41501B (Option) configuration:

- two pulse generator units (PGUs) (Option)
- one high power source monitor unit (HPSMU: 10 fA/2 μ V to 1 A/200 V) or two MPSMUs (Option).
- one ground unit (GNDU)

Specification Conditions:

The “supplemental information” and “typical” entries, in the following specifications are not warranted, but provide useful information about the functions and performance of the instruments.

The measurement and output accuracies are specified at the rear panel connector terminals when referenced to the Zero Check terminal under the following conditions:

1. $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ (double for 5 to 18 $^{\circ}\text{C}$, and for 28 to 40 $^{\circ}\text{C}$ if not noted otherwise).
2. After 40 minutes warm-up.
3. Ambient temperature changes less than $\pm 1\text{ }^{\circ}\text{C}$ after auto calibration execution.
4. Integration time: medium or long
5. Filter: ON (for SMUs)
6. Kelvin connection (for HRSMU, HPSMU, and GNDU)
7. Calibration period: 1 year

Hardware

- Agilent 4156B Precision Semiconductor Parameter Analyzer
- Agilent 4155B Semiconductor Parameter Analyzer
- Agilent 41501B SMU and Pulse Generator Expander

4156B Precision Semiconductor Parameter Analyzer

HRSMU (High Resolution SMU) Specifications

- Voltage Range, Resolution, and Accuracy
See Table 8-1.
- Current Range, Resolution, and Accuracy
See Table 8-2.
- Output terminal/connection
Dual triaxial connectors, Kelvin (remote sensing)
- Voltage/Current Compliance (Limiting)
The SMU can limit output voltage or current to prevent damaging the device under test.

Voltage 0 V to ± 100 V

Current ± 100 fA to ± 100 mA

Compliance accuracy Same as current (voltage) set accuracy.

- HRSMU supplemental information

Allowable cable resistance maximum $10\ \Omega$ (for both Force and Sence. Kelvin connection.)

Voltage source output resistance typical $0.2\ \Omega$ (Force line. Non-Kelvin connection.)

Voltage measurement input resistance $\geq 10^{15}\ \Omega$

Current source output resistance $\geq 10^{15}\ \Omega$ (10 pA range)

**Current compliance
setting accuracy**

(for opposite polarity)

For 10 pA to 10 nA range:

V/I setting accuracy $\pm 12\%$ of range

For 100 nA to 100 mA range:

V/I setting accuracy $\pm 2.5\%$ of range

Table 8-1 HRSMU Voltage Range, Resolution, and Accuracy

Voltage Range	Set Reso.	Set Accuracy	Meas. Reso.	Meas. Accuracy	Max. Current
± 2 V	100 μ V	$\pm(0.02\% + 400 \mu\text{V})$	2 μ V	$\pm(0.01\% + 200 \mu\text{V})$	100 mA
± 20 V	1 mV	$\pm(0.02\% + 3 \text{ mV})$	20 μ V	$\pm(0.01\% + 1 \text{ mV})$	100 mA
± 40 V	2 mV	$\pm(0.025\% + 6 \text{ mV})$	40 μ V	$\pm(0.015\% + 2 \text{ mV})$	100 mA ($V_{\text{out}} \leq 20$ V)
					50 mA ($20 \text{ V} < V_{\text{out}} \leq 40$ V)
± 100 V	5 mV	$\pm(0.03\% + 15 \text{ mV})$	100 μ V	$\pm(0.02\% + 5 \text{ mV})$	100 mA ($V_{\text{out}} \leq 20$ V)
					50 mA ($20 \text{ V} < V_{\text{out}} \leq 40$ V)
					20 mA ($40 \text{ V} < V_{\text{out}} \leq 100$ V)

Table 8-2 HRSMU Current Range, Resolution, and Accuracy

Current Range	Set Reso.	Set Accuracy ^a	Meas. Reso.	Measurement Accuracy ^a	Max. Voltage ^b
± 10 pA	10 fA	$\pm(4\% + 400 \text{ fA})^{c d}$	1 fA	$\pm(4\% + 20 \text{ fA} + 1 \text{ fA} \times V_{\text{out}}/100)^{c d}$	100 V
± 100 pA	10 fA	$\pm(4\% + 400 \text{ fA})^{c d}$	1 fA	$\pm(4\% + 40 \text{ fA} + 10 \text{ fA} \times V_{\text{out}} / 100)^{c d}$	100 V
± 1 nA	100 fA	$\pm(0.5\% + 0.7 \text{ pA} + 1 \text{ fA} \times V_{\text{out}})$	10 fA	$\pm(0.5\% + 0.4 \text{ pA} + 1 \text{ fA} \times V_{\text{out}})$	100 V
± 10 nA	1 pA	$\pm(0.5\% + 4 \text{ pA} + 10 \text{ fA} \times V_{\text{out}})$	10 fA	$\pm(0.5\% + 2 \text{ pA} + 10 \text{ fA} \times V_{\text{out}})$	100 V

Specifications
Hardware

Current Range	Set Reso.	Set Accuracy ^a	Meas. Reso.	Measurement Accuracy ^a	Max. Voltage ^b
±100 nA	10 pA	±(0.12 % + 40 pA + 100 fA × Vout)	100 fA	±(0.1 % + 20 pA + 100 fA × Vout)	100 V
±1 µA	100 pA	±(0.12 % + 400 pA + 1 pA × Vout)	1 pA	±(0.1 % + 200 pA + 1 pA × Vout)	100 V
±10 µA	1 nA	±(0.07 % + 4 nA + 10 pA × Vout)	10 pA	±(0.05 % + 2 nA + 10 pA × Vout)	100 V
±100 µA	10 nA	±(0.07 % + 40 nA + 100 pA × Vout)	100 pA	±(0.05 % + 20 nA + 100 pA × Vout)	100 V
±1 mA	100 nA	±(0.06 % + 400 nA + 1 nA × Vout)	1 nA	±(0.04 % + 200 nA + 1 nA × Vout)	100 V
±10 mA	1 µA	±(0.06 % + 4 µA + 10 nA × Vout)	10 nA	±(0.04 % + 2 µA + 10 nA × Vout)	100 V
±100 mA	10 µA	±(0.12 % + 40 µA + 100 nA × Vout)	100 nA	±(0.1 % + 20 µA + 100 nA × Vout)	100 V (Iout ≤ 20mA)
					40V (20mA < Iout ≤ 50mA)
					20V (50mA < Iout ≤ 100mA)

- a. Vout is the output voltage in volts.
b. Iout is the output current in amps.
c. The accuracy is applicable when offset cancellation has been performed.
d. The offset current specification is multiplied by one of the following factors depending upon the ambient temperature and humidity. See the table below.

Temperature	Humidity	
	5 to 60 % RH	60 to 80 % RH
5 to 18 °C	× 2	× 2
18 to 28 °C	× 1	× 2
28 to 40 °C	× 2	× 5

For example, accuracy specifications are given as ± % of set/measured value (0.04 %) plus offset value (200 nA + 1 nA × Vout) for the 1 mA range. The offset value consists of a fixed part determined by the set/measurement range and a proportional part that is multiplied by Vout or Vout/100.

HRSMU, MPSMU, and HPSMU Supplemental Information

Capacitive load	maximum 1000 pF
Guard capacitance	maximum 900 pF
Shield capacitance	maximum 5000 pF
Guard offset voltage	maximum ± 1 mV
Noise characteristics	(typical, filter ON) Voltage source: 0.01 % of V range (rms) Current source: 0.1 % of I range (rms) Voltage monitor: 0.02 % of V range (p-p) Current monitor: 0.2 % of I range (p-p)
Output overshoot	(typical, filter ON) Voltage source: 0.03 % of V range Current source: 1 % of I range
Range switching transient noise	(typical, filter ON) Voltage ranging: 250 mV Current ranging: 10 mV
Slew rate	maximum 0.2 V/ μ s

Specifications

Hardware

VSU (Voltage Source Unit) Specifications

- Voltage Range, Resolution, and Accuracy

Voltage Range	Resolution	Accuracy	Max. Output Current
± 20 V	1 mV	$\pm(0.05 \% \text{ of setting} + 10 \text{ mV})^a$	100 mA

a. Specification is applicable under no load current.

- VSU supplemental information

Output resistance typical 0.2 Ω

Capacitive load maximum 10 μF

Slew rate maximum 0.2 V/ μs

Current limit typical 120 mA

Output Noise typical 1 mV rms

VMU (Voltage Monitor Unit) Specifications

- Voltage Range, Resolution, and Accuracy

Grounded measurement mode

Voltage Range	Meas. Reso.	Meas. Accuracy
± 2 V	2 μ V	$\pm(0.02 \% + 200 \mu\text{V})$
± 20 V	20 μ V	$\pm(0.02 \% + 1 \text{ mV})$

Differential measurement mode

Differential Voltage Range	Meas. Reso.	Meas. Accuracy	Max. Common Mode Voltage
± 0.2 V	1 μ V	$\pm(0.03 \% + 100 \mu\text{V} + 1.3 \mu\text{V} \times V_i^a)$	± 20 V
± 2 V	2 μ V	$\pm(0.02 \% + 200 \mu\text{V} + 13 \mu\text{V} \times V_i^a)$	± 20 V

a. V_i is the input voltage of VMU2 in volts.

For example, accuracy specifications are given as \pm % of measured value (0.02 %) plus offset value (200 μ V + 13 μ V \times V_i) for the 2 V range. The differential mode offset value consists of a fixed part determined by the measurement range and proportional part that is multiplied by V_i .

- VMU supplemental information

Input impedance $\geq 1 \text{ G}\Omega$

Input leakage current $\leq 500 \text{ pA}$ (at 0 V)

Measurement noise typical 0.01 % of range (p-p)

Differential mode measurement noise typical 0.005 % of range (p-p)

4155B Semiconductor Parameter Analyzer

MPSMU (Medium Power SMU) Specifications

- Voltage Range, Resolution, and Accuracy
See Table 8-3.
- Current Range, Resolution, and Accuracy
See Table 8-4.
- Output terminal/connection
Single triaxial connector, non-Kelvin (no remote sensing)
- Voltage/Current Compliance (Limiting)
The SMU can limit output voltage or current to prevent damaging the device under test.

Voltage 0 V to ± 100 V

Current ± 1 pA to ± 100 mA

Compliance accuracy Same as current (voltage) set accuracy.

- MPSMU supplemental information

Voltage source output resistance typical 0.3Ω

Voltage measurement input resistance $\geq 10^{13} \Omega$

Current source output resistance $\geq 10^{13} \Omega$ (1 nA range)

Current compliance setting accuracy (for opposite polarity)
For 1 nA to 10 nA range:
V/I setting accuracy ± 12 % of range
For 100 nA to 100 mA range:
V/I setting accuracy ± 2.5 % of range

Table 8-3 MPSMU Voltage Range, Resolution, and Accuracy

Voltage Range	Set Reso.	Set Accuracy	Meas. Reso.	Meas. Accuracy	Max. Current
±2 V	100 µV	$\pm(0.03\% + 900\ \mu\text{V} + 0.3 \times I_{\text{out}})$	2 µV	$\pm(0.02\% + 700\ \mu\text{V} + 0.3 \times I_{\text{out}})$	100 mA
±20 V	1 mV	$\pm(0.03\% + 4\ \text{mV} + 0.3 \times I_{\text{out}})$	20 µV	$\pm(0.02\% + 2\ \text{mV} + 0.3 \times I_{\text{out}})$	100 mA
±40 V	2 mV	$\pm(0.03\% + 7\ \text{mV} + 0.3 \times I_{\text{out}})$	40 µV	$\pm(0.02\% + 3\ \text{mV} + 0.3 \times I_{\text{out}})$	100 mA ($V_{\text{out}} \leq 20\ \text{V}$)
					50 mA ($20\ \text{V} < V_{\text{out}} \leq 40\ \text{V}$)
±100 V	5 mV	$\pm(0.04\% + 15\ \text{mV} + 0.3 \times I_{\text{out}})$	100 µV	$\pm(0.03\% + 5\ \text{mV} + 0.3 \times I_{\text{out}})$	100 mA ($V_{\text{out}} \leq 20\ \text{V}$)
					50 mA ($20\ \text{V} < V_{\text{out}} \leq 40\ \text{V}$)
					20 mA ($40\ \text{V} < V_{\text{out}} \leq 100\ \text{V}$)

Table 8-4 MPSMU Current Range, Resolution, and Accuracy

Current Range	Set Reso.	Set Accuracy ^a	Meas. Reso.	Measurement Accuracy ^a	Max. Voltage ^b
±1 nA	100 fA	$\pm(0.5\% + 3\ \text{pA} + 2\ \text{fA} \times V_{\text{out}})$	10 fA	$\pm(0.5\% + 3\ \text{pA} + 2\ \text{fA} \times V_{\text{out}})$	100 V
±10 nA	1 pA	$\pm(0.5\% + 7\ \text{pA} + 20\ \text{fA} \times V_{\text{out}})$	10 fA	$\pm(0.5\% + 5\ \text{pA} + 20\ \text{fA} \times V_{\text{out}})$	100 V
±100 nA	10 pA	$\pm(0.12\% + 50\ \text{pA} + 200\ \text{fA} \times V_{\text{out}})$	100 fA	$\pm(0.1\% + 30\ \text{pA} + 200\ \text{fA} \times V_{\text{out}})$	100 V
±1 µA	100 pA	$\pm(0.12\% + 400\ \text{pA} + 2\ \text{pA} \times V_{\text{out}})$	1 pA	$\pm(0.1\% + 200\ \text{pA} + 2\ \text{pA} \times V_{\text{out}})$	100 V
±10 µA	1 nA	$\pm(0.12\% + 5\ \text{nA} + 20\ \text{pA} \times V_{\text{out}})$	10 pA	$\pm(0.1\% + 3\ \text{nA} + 20\ \text{pA} \times V_{\text{out}})$	100 V
±100 µA	10 nA	$\pm(0.12\% + 40\ \text{nA} + 200\ \text{pA} \times V_{\text{out}})$	100 pA	$\pm(0.1\% + 20\ \text{nA} + 200\ \text{pA} \times V_{\text{out}})$	100 V
±1 mA	100 nA	$\pm(0.12\% + 500\ \text{nA} + 2\ \text{nA} \times V_{\text{out}})$	1 nA	$\pm(0.1\% + 300\ \text{nA} + 2\ \text{nA} \times V_{\text{out}})$	100 V

Specifications Hardware

Current Range	Set Reso.	Set Accuracy ^a	Meas. Reso.	Measurement Accuracy ^a	Max. Voltage ^b
±10 mA	1 µA	$\pm(0.12\% + 4\text{ }\mu\text{A} + 20\text{ nA} \times \text{Vout})$	10 nA	$\pm(0.1\% + 2\text{ }\mu\text{A} + 20\text{ nA} \times \text{Vout})$	100 V
±100 mA	10 µA	$\pm(0.12\% + 50\text{ }\mu\text{A} + 200\text{ nA} \times \text{Vout})$	100 nA	$\pm(0.1\% + 30\text{ }\mu\text{A} + 200\text{ nA} \times \text{Vout})$	100 V ($I_{\text{out}} \leq 20\text{mA}$)
					40V ($20\text{mA} < I_{\text{out}} \leq 50\text{mA}$)
					20V ($50\text{mA} < I_{\text{out}} \leq 100\text{mA}$)

a. Vout is the output voltage in volts.

b. Iout is the output current in amps.

For example, accuracy specifications are given as $\pm\%$ of set/measured value (0.1 %) plus offset value ($30\text{ pA} + 200\text{ fA} \times \text{Vout}$) for the 100 nA range. The offset value consists of a fixed part determined by the set/measurement range and a proportional part that is multiplied by Vout.

VSU (Voltage Source Unit) Specifications

Same as the 4156B VSU.

VMU (Voltage Monitor Unit) Specifications

Same as the 4156B VMU.

41501B SMU and Pulse Generator Expander

HPSMU (High Power SMU) Specifications

- Voltage Range, Resolution, and Accuracy
See Table 8-5.
- Current Range, Resolution, and Accuracy
See Table 8-6.
- Output terminal/connection
Dial triaxial connectors, Kelvin (remote sensing)
- Voltage/Current Compliance (Limiting)
The SMU can limit output voltage or current to prevent damaging the device under test.

Voltage 0 V to ± 200 V

Current ± 1 pA to ± 1 A

Compliance accuracy Same as current (voltage) set accuracy.

- HPSMU supplemental information

Allowable cable resistance (Kelvin connection.)

Force: maximum $0.7\ \Omega$ (100 mA to 1A)

Force: maximum $10\ \Omega$ (≤ 100 mA)

Sense: maximum $10\ \Omega$

Voltage source output resistance typical $0.2\ \Omega$ (Force line. Non Kelvin connection.)

Voltage measurement input resistance $\geq 10^{13}\ \Omega$

Current source output resistance $\geq 10^{13}\ \Omega$ (1 nA range)

Current compliance setting accuracy (for opposite polarity)

For 1 nA to 10 nA range:

V/I setting accuracy $\pm 12\%$ of range

For 100 nA to 1 A range:

V/I setting accuracy $\pm 2.5\%$ of range

Specifications
Hardware

Table 8-5 HPSMU Voltage Range, Resolution, and Accuracy

Voltage Range	Set Reso.	Set Accuracy	Meas. Reso.	Meas. Accuracy	Max. Current
±2 V	100 µV	±(0.03 % + 900 µV)	2 µV	±(0.02 % + 700 µV)	1 A
±20 V	1 mV	±(0.03 % + 4 mV)	20 µV	±(0.02 % + 2 mV)	1 A
±40 V	2 mV	±(0.03 % + 7 mV)	40 µV	±(0.02 % + 3 mV)	500 mA
±100 V	5 mV	±(0.04 % + 15 mV)	100 µV	±(0.03 % + 5 mV)	125 mA
±200 V	10 mV	±(0.045 % + 30 mV)	200 µV	±(0.035 % + 10 mV)	50 mA

Table 8-6 HPSMU Current Range, Resolution, and Accuracy

Current Range	Set Reso.	Set Accuracy ^a	Meas. Reso.	Measurement Accuracy ^a	Max. Voltage ^b
±1 nA	100 fA	±(0.5 % + 3 pA + 2 fA × Vout)	10 fA	±(0.5 % + 3 pA + 2 fA × Vout)	200 V
±10 nA	1 pA	±(0.5 % + 7 pA + 20 fA × Vout)	10 fA	±(0.5 % + 5 pA + 20 fA × Vout)	200 V
±100 nA	10 pA	±(0.12 % + 50 pA + 200 fA × Vout)	100 fA	±(0.1 % + 30 pA + 200 fA × Vout)	200 V
±1 µA	100 pA	±(0.12 % + 400 pA + 2 pA × Vout)	1 pA	±(0.1 % + 200 pA + 2 pA × Vout)	200 V
±10 µA	1 nA	±(0.12 % + 5 nA + 20 pA × Vout)	10 pA	±(0.1 % + 3 nA + 20 pA × Vout)	200 V
±100 µA	10 nA	±(0.12 % + 40 nA + 200 pA × Vout)	100 pA	±(0.1 % + 20 nA + 200 pA × Vout)	200 V
±1 mA	100 nA	±(0.12 % + 500 nA + 2 nA × Vout)	1 nA	±(0.1 % + 300 nA + 2 nA × Vout)	200 V
±10 mA	1 µA	±(0.12 % + 4 µA + 20 nA × Vout)	10 nA	±(0.1 % + 2 µA + 20 nA × Vout)	200 V
±100 mA	10 µA	±(0.12 % + 50 µA + 200 nA × Vout)	100 nA	±(0.1 % + 30 µA + 200 nA × Vout)	200 V (Iout ≤ 50 mA)
					100 V (50mA < Iout ≤ 100mA)

Specifications
Hardware

Current Range	Set Reso.	Set Accuracy ^a	Meas. Reso.	Measurement Accuracy ^a	Max. Voltage ^b
±1 A	100 μ A	$\pm(0.5 \% + 500 \mu\text{A} + 2 \mu\text{A} \times \text{Vout})$	1 μ A	$\pm(0.5 \% + 300 \mu\text{A} + 2 \mu\text{A} \times \text{Vout})$	200 V ($I_{\text{out}} \leq 50 \text{ mA}$)
					100 V ($50\text{mA} < I_{\text{out}} \leq 125\text{mA}$)
					40 V ($125\text{mA} < I_{\text{out}} \leq 500\text{mA}$)
					20 V ($500 \text{ mA} < I_{\text{out}} \leq 1 \text{ A}$)

- a. Vout is the output voltage in volts.
b. Iout is the output current in amps.

For example, accuracy specifications are given as \pm % of set/measured value (0.1 %) plus offset value ($30 \text{ pA} + 200 \text{ fA} \times \text{Vout}$) for the 100 nA range. The offset value consists of a fixed part determined by the set/measurement range and a proportional part that is multiplied by Vout.

MPSMU Specifications

Same as the 4155B MPSMU.

GNDU (Ground Unit) Specifications

- Specifications

Output voltage	0 V \pm 100 μ V
Sink current	maximum 1.6 A
Output terminal/connection	Single triaxial connector, Kelvin (remote sensing)
- Supplemental information

Load capacitance	$\leq 1 \mu\text{F}$
Cable resistance	Force $\leq 1 \Omega$ Sense $\leq 10 \Omega$

Specifications
Hardware

PGU (Pulse Generator Unit) Specifications

- General

Modes	pulse or constant
Amplitude	0 Vpp to 40 Vpp
Window	-40.0 V to +40.0 V
Maximum current	± 200 mA (pulse width: ≤ 1 ms, Average current ≤ 100 mA) ± 100 mA
Output impedance	50 Ω and low impedance (≤ 1 Ω)
Burst count range	1 to 65535
Trigger output	Level: TTL Timing: same timing and width as PGU1 pulse output.

- Pulse/dc Output Voltage and Accuracy

See Table 8-7.

- Timing Parameters

See Table 8-8.

- Accuracy of Timing parameters

The following data is applied when leading time and trailing time are the same value.

Period	$\pm(2 \% + 2 \text{ ns})$
Width	$\pm(3 \% + 2 \text{ ns})$
Delay	$\pm(2 \% + 40 \text{ ns})$

- Leading Time and Trailing Time

See Table 8-9.

- Restrictions of Pulse Timing Parameters Setup

- Pulse width < Pulse period
- Delay time < Pulse period
- Leading time < Pulse width $\times 0.8$
- Trailing time < (Pulse period - Pulse width) $\times 0.8$

- PGU supplemental information

Overshoot (Undershoot, ringing)	$\leq \pm 5\%$ of amplitude ± 10 mV (50 Ω output impedance to 50 Ω load)
Pulse width jitter	0.2 % + 100 ps
Pulse period jitter	0.2 % + 100 ps
Slew rate	maximum 100 V/ μ s (50 Ω output impedance to 50 Ω load)
Noise	0.2 % of range (at dc output)

Table 8-7

Pulse/dc Output Voltage and Accuracy

Set Parameter	Voltage Range	Resolution	Accuracy ^a
Base ^b	± 20 V	4 mV	$\pm(1\%$ of Base + 50 mV + 1 % of Pulse)
	± 40 V	8 mV	$\pm(1\%$ of Base + 50 mV + 1 % of Pulse)
Pulse	± 20 V	4 mV	$\pm(3\%$ of Base + 50 mV)
	± 40 V	8 mV	$\pm(3\%$ of Base + 50 mV)

a. Accuracy is specified at leading = trailing time = 1 μ s.

b. dc output is performed by the Base parameter.

Specifications
Hardware

Table 8-8 **Timing Parameters**

Range ^a	Period	Width	Delay	Set resolution
1	2 μ s to 100 μ s	1 μ s to 99.9 μ s	0 to 100 μ s	0.1 μ s
2	100 μ s to 1000 μ s	1 μ s to 999 μ s	0 to 1000 μ s	1 μ s
3	1 ms to 10 ms	0.01 ms to 9.99 ms	0 to 10 ms	10 μ s
4	10 ms to 100 ms	0.1 ms to 99.9 ms	0 to 100 ms	100 μ s
5	100 ms to 1000 ms	1 ms to 999 ms	0 to 1000 ms	1 ms
6	1 s to 10 s	0.01 s to 9.99 s	0 to 10 s	10 ms

a. Period, width, and delay of PGU1 and PGU2 must be in the same range.

Table 8-9 **Leading Time and Trailing Time**

Range ^a	Leading/Trailing Time	Set Resolution	Accuracy
1	100 ns to 1000 ns	1 ns	$\pm(5 \% + 10 \text{ ns})$
2	0.5 μ s to 10.0 μ s	10 ns	$\pm(5 \% + 10 \text{ ns})$
3	5.0 μ s to 100.0 μ s	100 ns	$\pm(5 \% + 10 \text{ ns})$
4	50 μ s to 1000 μ s	1 μ s	$\pm(5 \% + 10 \text{ ns})$
5	0.5 ms to 10.0 ms	10 μ s	$\pm(5 \% + 10 \text{ ns})$

a. Leading time and trailing time for a PGU must be in the same range.

Functions

- Measurement setup
- Measurement capability
- Arithmetic and analysis functions
- Output
- Data storage
- Repeating and automating test
- Other capabilities

Measurement Setup

- Fill-in-the-blanks using front-panel or full-size external keyboard
- Load settings from a diskette
- Program using internal Instrument BASIC or via GPIB
- HELP function
- Library: Default Measure Setup, Vce-Ic, Vds-Id, Vgs-Id, and Vf-If are pre-defined softkeys
- User-defined measurement setup library
- Auto file load function on power-up

Specifications

Functions

Measurement Capability

The 4155B/4156B can perform dc or pulsed force/measure, and stress force. For dc, voltage/current sweep and sampling (time domain) measurements are available.

Voltage/Current Sweep Measurement Characteristics

SMUs or VSUs can be set using VAR1 (primary sweep), VAR2 (subordinate sweep), VAR1' (synchronous sweep), or CONST (constant output).

- VAR1

Primary sweep, controls the staircase (dc or pulsed) voltage or current sweep.

Number of steps Maximum 1001 for one VAR1 sweep.

Sweep type Linear or logarithmic

Sweep direction Single or double sweep

Hold time Initial wait time or wait time after VAR2 is set, 0 to 655.35 s with 10 ms resolution

Delay time Wait time from VAR1 step to the start of the measurement, 0 to 65.535 s with 100 μ s resolution

- VAR2

Subordinate linear staircase or linear pulsed sweep. After primary sweep is completed, the VAR2 unit output is incremented. Maximum number of steps is 128.

- VAR1'

Staircase or pulsed sweep synchronized with the VAR1 sweep. Sweep is made with a user specified ratio and offset value. VAR1' output is calculated as $\text{VAR1}' = a \times \text{VAR1} + b$, where "a" is the user-specified ratio and "b" is the user-specified offset value.

- CONSTANT

A source unit can be set as a constant voltage or current source depending on the unit.

- PULSE

One of SMUs can be set as a pulse source.

Pulse width 0.5 ms to 100 ms, 100 μ s resolutions.

Pulse period 5 ms to 1 s (\geq pulse width + 4 ms), 100 μ s resolutions.

SMU pulse setting accuracy (supplemental information):

Conditions: fixed range measurement except multi channel measurement

Width 0.5 % + 50 μ s

Period 0.5 % + 100 μ s

Trigger out delay (for pulsed measurements.)

0 to 32.7 ms with 100 μ s resolution (< pulse width)

Sampling (Time Domain) Measurement Characteristics

Displays the time sampled voltage/current data versus time. The source unit is SMU, VSU, or PGU.

Sampling points Maximum 10,001 (Linear)

Sampling mode linear, log, and thinned-out

Sampling interval For linear scale (auto mode):

- 60 μ s to 480 μ s range, 20 μ s resolution
- 480 μ s to 1 s range, 80 μ s resolution
- 1 s to 65.535 s range, 2 ms resolution

For linear scale (no limit mode), log scale, and thinned-out modes:

- 560 μ s (720 μ s at thinned-out mode) to 1 s range, 80 μ s resolution
- 1 s to 65.535 s range, 2 ms resolution

Hold time initial wait time, 0.03 to 655.35 s, 100 μ s resolution.

Stop condition a condition to stop the sampling can be defined.

Sampling interval setting accuracy (supplemental data)

- 0.5 % + 10 μ s (sampling interval \leq 480 μ s)
- 0.5 % + 10 μ s (560 μ s \leq sampling interval < 2 ms)
- 0.5 % + 100 μ s (2 ms \leq sampling interval)

The thinned-out mode is similar to reverse-log sampling. Sampling measurement continues by thinning out older data until the sampling completion condition is satisfied.

Specifications Functions

There are the following restrictions if initial interval is less than 2 ms.

- Number of measurement channels must be 1.
- Measurement ranging must be the fixed range.
- Stop condition must be disabled.

Stress Force Characteristics

SMU, VSU, and PGU output can be forced for the user specified period.

Stress time	500 μ s to 31,536,000 s (365 days)
Resolution	100 μ s ($500 \mu\text{s} \leq \text{stress time} \leq 10 \text{ s}$) 10 ms ($10 \text{ s} \leq \text{stress time} \leq 31,536,000 \text{ s}$)
Burst pulse count	1 to 65,535 (PGU only)
Trigger	The 4155B/4156B outputs a gate trigger while stress channels are forcing stress.

Knob Sweep

In the knob sweep mode, sweep range is controlled instantaneously with the front-panel rotary knob. Only the CHANNELS: CHANNEL DEFINITION screen needs to be defined.

Standby Mode

Measurement units in "Standby" remain programmed to their specified output value even as other measurement units are reset for the next measurement.

Other Characteristics (measurement control)

Measurement control	single, append, repeat, and stop
Stress control	stress force, and stop
SMU settings capabilities	limited auto-ranging, voltage/current compliance, power compliance, automatic sweep abort functions, self-test, and self calibration.

Arithmetic and Analysis Functions

- Arithmetic Functions

User functions up to six USER FUNCTIONS can be defined using arithmetic expressions. Measured data and analyzed variables from graphics analysis (marker, cursor and line data) can be used in the computation. The results can be displayed on the screen.

Arithmetic operators

+, -, *, /, ^, LGT (logarithm, base 10), LOG (logarithm, base e), EXP (Napierian constant), DELTA, DIFF (differential), INTEG (integration), MAVG (moving average), SQRT, ABS (absolute), MAX, MIN, AVG (averaging), COND (conditional evaluation).

Physical constants Keyboard constants are stored in memory as follows.

- q : Electron Charge, 1.602177 E-19 C
- k : Boltzmann's Constant, 1.380658 E-23
- e : Dielectric Constant of vacuum, 8.854188 E-12

Engineering units The following unit symbols are also available on the keyboard. m (10^{-3}), μ (10^{-6}), u (10^{-6}), n (10^{-9}), p (10^{-12}), f (10^{-15}), k (10^3), M (10^6), G (10^9)

- Analysis Capabilities

Overlay graph comparison

a graphic plot can be stored and later recalled as an overlay plane. Four overlay planes can be stored. One plane can be overlaid onto the current data.

Marker marker to min/max, interpolation, direct marker, and marker skip

Cursor long and short, direct cursor

Line two lines, normal mode, grad mode, tangent mode, and regression mode

Scaling auto scale and zoom

Specifications

Functions

Data variable display

Up to two user defined parameters can be displayed on measurement result screen.

Read Out Function

The read out functions are built-in functions for reading various values related to the marker, cursor, or line.

Automatic Analysis Function

On a graphics plot, the markers and lines can be automatically located using the auto analysis setup. Parameters can be automatically determined using automatic analysis, user function, and read out functions.

User Variable

Displays the data on the screen via GPIB or Instrument BASIC.

Output

- Display

Display modes graphics and list

Graphics display two-axes (X-Y) or three-axes (X-Y1,Y2) plot of source current/voltage, measured current/voltage, time, or calculated USER FUNCTION data.

List display measurement data and calculated USER FUNCTION data are listed in conjunction with VAR1 step number or time domain sampling step number. Up to eight data sets can be displayed.

Display 8.4 inch diagonal color active matrix LCD, 640 dot (H) by 480 dot (V)

- Hard Copy Functions

Graphics hard copy measured data and all data appearing on the screen can be output via GPIB, parallel, or network interface to a supported plotter or printer. PCL and HP-GL formats are supported (selectable).

Text hard copy	print out setup information or measured data list as an ASCII text via GPIB, parallel, or network interface to a supported plotter or printer. PCL and HP-GL formats are supported (selectable).
Hard copy file	hard copy output file can be stored to an internal or network mass storage devices instead of sending it to a printer or plotter. The data can be stored in PCL, HP-GL, or TIF formats.
Hard copy via network interface	lpr client capability

Data Storage

- Internal mass storage device

Mass storage device	built-in 3.5 inch flexible disk drive
Media	3.5 inch 2HD or 2DD diskette
Format type	HP LIF and DOS
User area	1.44 Mbyte (2HD) or 720 Kbyte (2DD)
File types	auto start program file, initial setup file, measurement setup file, measurement setup/result file, stress setup file, customize file, hard copy data file, and Instrument BASIC program and data file.
Program files	data made by HP BASIC program and data made by Instrument BASIC program are compatible.
- Network mass storage device

Mass storage device	an NFS mountable mass storage device
File types	auto start program file, initial setup file, measurement setup file, measurement setup/result file, stress setup file, customize file and hard copy data file.
Number of files	maximum 199 files (including directories) in the working directory.
- Data Storage supplemental information

Volume size	available bytes = 1457 Kbyte (for 2HD DOS formatted diskette)
--------------------	---

Specifications
Functions

File size	Measurement setup: 3843 byte Stress setup: 601 byte Measurement setup/result: typical 15387 byte (VAR1: 101, VAR2: 5) Customized system setup: 1661 byte Hardcopy data: 30317 byte (monochrome PCL, 75DPI file) Hardcopy data: 38702 byte (monochrome TIFF file)
Number of files	maximum 199 can be stored (for HP LIF format).

Repeating and Automating Test

- Instrument Control

Function control internal or external computer can control the 4155B/4156B functions via GPIB interface.

Commands set SCPI Commands set
4155B/4156B FLEX Commands set
4145B Syntax Commands set

Program memory Using the 4155B/4156B FLEX Commands set, program code can be stored in the 4155B or 4156B. Maximum number of program set is 255.

External instrument

remote control internal Instrument BASIC controller can control external equipment via GPIB interface.

- Instrument BASIC

Instrument BASIC is a subset of HP BASIC.

Functions arithmetic operation, binary operation, string manipulation, logical operation, array operation, program flow control, event-initiated branching, program editing and debugging support, mass storage operation, instrument control, real-time clock, softkey operation, and graphics.

Typing aid 4145B ASP (Auto Sequence Program) like syntax softkeys are available in Instrument BASIC. An 4145B ASP file cannot be read by the 4155B/4156B.

Remote control Instrument BASIC is remote controllable from an external computer via the GPIB interface.

IBASIC supplemental information:

Program (text) area 16 Kbyte.

Variable/stack area 500 Kbyte.

Common variable area 600 Kbyte. This size is decreased when hard copy or disk operation is executed.

- Trigger

Input external trigger input starts a sweep or sampling measurement or can be used as a trigger input for continuing Instrument BASIC program.

Input level TTL level, negative or positive edge trigger

Output external trigger can be generated by the following events: start of each sweep measurement step, start of each pulse (SMU) output, while the stress source is forcing, and Instrument BASIC trigger out command execution.

Output level TTL level, negative or positive logic

Other Capabilities

- 4145B Data Compatibility and 4145B Syntax Commands

Setup/data file loads measurement setup and data of the 4145B

GPIO program GPIO programs for the 4145B can be used when the 4145B syntax command set is selected. There is a possibility that GPIO programs for the 4145B need to be modified before using.

- Interfaces

- GPIO interface: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C4, C11, E2

- Parallel interface

- RJ45 connector : Ethernet IEEE 802.3 10BASE-T for a 10Mbps CSMA/CD local area network

- External keyboard : compatible PC-style 101-key keyboard (mini DIN connector)

- Interlock and LED connector

Specifications

Functions

- R-BOX control connector
- Trigger in/out
- SMU/PGU Selector control connector (Agilent 41501A/B)
- Sample Application Programs
 - Flash EEPROM test
 - TDDB
 - Constant I (Electromigration test)
 - V-Ramp test
 - J-Ramp test
 - SWEAT
 - GO/NO-GO test
 - HCI degradation test
 - Charge pumping test
- Agilent VEE Sample Application Programs
 - Vth measurement using an 4155B/4156B, an E5250A, and a prober
- VXIplug&play drivers
 - VXIplug&play drivers for the 4155B and 4156B
 - VXIplug&play drivers for the E5250A

General Specifications

- Temperature range
 - Operating** +10 °C to +40 °C (with disk drive operation)
+5 °C to +40 °C (without disk drive operation)
 - Storage** -22 °C to +60 °C
- Humidity range
 - Operating** 20 % to 80 % RH ,non-condensing and wet bulb temperature ≤ 29 °C (with disk drive operation)
15 % to 80 % RH ,non-condensing and wet bulb temperature ≤ 29 °C (without disk drive operation)
 - Storage** 5 % to 90 % RH ,non-condensing and wet bulb temperature ≤ 39 °C
- Altitude
 - Operating** 0 to 2,000 m
 - Storage** 0 to 4,600 m
- Power requirement
90 V to 264 V, 47 Hz to 63 Hz
- Maximum VA
 - 4155B/4156B** 450 VA (Max)
 - 41501B** 350 VA (Max)
- Regulatory Compliance
 - EMC** EN55011(1991) Group 1 ,Class A
EN50082-1 (1992)
 - Safety** CSA C22.2 No.1010.1 (1992)
IEC1010-1 (1990) + A2/EN61010-1 (1993)
- Dimensions
 - 4155B/4156B** 426 mmW by 235 mmH by 600 mmD
 - 41501B** 426 mmW by 190 mmH by 600 mmD
- Weight(approx.)
 - 4155B/4156B** 21 kg
 - 41501B** 16 kg (option 412. with HPSMU and 2 PGUs.)

Furnished Accessories

The following are the furnished accessories for the 4155B/4156B.

- Triaxial Cable, 4 ea. (4155B)
- Kelvin Triaxial Cable, 4 ea. (4156B)
- Coaxial Cable, 4 ea.
- Interlock Cable, 1 ea.
- Keyboard, 1 ea.
- User Manual, 1 set
- Sample Application Program Disk, 1 ea.
- VEE Sample Program Disk, 1 ea.
- 4155B/4156B VXIplug&play Drivers Disk, 1ea.
- E5250A VXIplug&play Drivers Disk, 1ea.
- LAN Interface Test Adapter, 1 ea.

Accessories and Options

The following table lists accessories and options for Agilent 4155B/4156B.

Product Number	Options Number	Description
4155B		Semiconductor Parameter Analyzer
	050	50 Hz line frequency
	060	60 Hz line frequency
	0B0	Delete manual set
	0B1	Add manual set
	1BN	Mil std 45662A calibration certification
	1BP	Mil std 45662A calibration w/ test data
	200	Substitute 1.5 m length cables for 4155B
	201	Substitute 1.5 m length cables for 41501B
	280	SMU/Pulse Generator Selector (1.5 m cable)
	281	SMU/Pulse Generator Selector (3.0 m cable)
	282	2nd SMU/Pulse Generator Selector
	298	R-Box (1.5 m cable)
	299	R-Box (3.0 m cable)
	301	Add 16495H w/opt.001 Connector Plate
	302	Add 16495H w/opt.002 Connector Plate
	311	Add 16495J w/opt.001 Connector Plate
	312	Add 16495J w/opt.002 Connector Plate
	402	Add 41501B with 2 PGUs
	410	Add 41501B with HPSMU
	412	Add 41501B with HPSMU and 2 PGUs
	420	Add 41501B with 2 MPSMUs
	412	Add 41501B with 2 MPSMUs and 2 PGUs
	ABA	U.S. - English localization
	ABJ	Japan - Japanese localization
	UK6	Commercial cal. certification w/ test data

Accessories and Options

Product Number	Options Number	Description
4156B		Precision Semiconductor Parameter Analyzer
	010	Delete Kelvin Triaxial Cable from 4156B
	050	50 Hz line frequency
	060	60 Hz line frequency
	0B0	Delete manual set
	0B1	Add manual set
	1BN	Mil std 45662A calibration certification
	1BP	Mil std 45662A calibration w/ test data
	200	Substitute 1.5 m length cables for 4156B
	201	Substitute 1.5 m length cables for 41501B
	280	SMU/Pulse Generator Selector (1.5 m cable)
	281	SMU/Pulse Generator Selector (3.0 m cable)
	282	2nd SMU/Pulse Generator Selector
	283	2nd SMU/Pulse Generator Selector (3.0 m)
	298	R-Box (1.5 m cable)
	299	R-Box (3.0 m cable)
	301	Add 16495H w/opt.001 Connector Plate
	302	Add 16495H w/opt.002 Connector Plate
	311	Add 16495J w/opt.001 Connector Plate
	312	Add 16495J w/opt.002 Connector Plate
	402	Add 41501B with 2 PGUs
	410	Add 41501B with HPSMU
	412	Add 41501B with HPSMU and 2 PGUs
	420	Add 41501B with 2 MPSMUs
	412	Add 41501B with 2 MPSMUs and 2 PGUs
	ABA	U.S. - English localization
	ABJ	Japan - Japanese localization

Accessories and Options

Product Number	Options Number	Description
4156B	UK6	Commercial cal. certification w/ test data
41501B		SMU and Pulse Generator Expander
	201	Substitute 1.5 m length cables for 41501B
	402	Add 41501B with 2 PGUs
	410	Add 41501B with HPSMU
	412	Add 41501B with HPSMU and 2 PGUs
	420	Add 41501B with 2 MPSMUs
	422	Add 41501B with 2 MPSMUs and 2 PGUs
16353A		Standard resistor set
16435A		Interlock cable adapter
16440A		SMU/Pulse generator selector
	001	Control cable (1.5 m)
	002	Control cable (3.0 m)
	003	Control cable (0.4 m) for 2nd selector
16441A		R-Box
	001	Control cable (1.5 m)
	002	Control cable (3.0 m)
16442A		Test Fixture
	010	Add 1.5 m triax cables for 4156B
	011	Add 3.0 m triax cables for 4156B
	800	Extra Blank Teflon Board
	801	0.1 inch pitch universal socket module
	802	0.075 inch pitch universal socket module
	803	0.05 inch pitch universal socket module
	810	Extra connection pin set
	811	Extra wire set
	812	Extra wire set

Accessories and Options

Product Number	Options Number	Description
16442A	813	Extra wire set
	814	Extra wire set
	821	Socket module (transistor)
	822	Socket module (18-pin DIP)
	823	Extra socket module (28-pin DIP socket)
	824	Socket module (8-pin TO package)
	825	Socket module (10-pin TO package)
	826	Extra socket module (12 pin TO package)
	830	Socket module (TO3 TO66 package)
	831	Socket module (In-line package)
	832	Extra socket module (Axial lead package)
	890	Extra accessory case
16493J		Interlock cable for 4155B/4156B
	001	Interlock cable (1.5 m) for 4155B/4156B
	002	Interlock cable (3.0 m) for 4155B/4156B
16493K		Kelvin triaxial cable
	001	Kelvin triaxial cable (1.5 m)
	002	Kelvin triaxial cable (3.0 m)
16495H		Connector Plate w/6 Triax., 6 BNCs, Intlk., GNDU
	001	Bulkhead Feedthru
	002	Connectors to contacts for soldering
16495J		Connector Plate w/8 Triax., 4 BNCs, Intlk., GNDU
	001	Bulkhead Feedthru
	002	Connectors to contacts for soldering

Accessories and Options

If You Have A Problem

This chapter explains how to solve a problem or how to read status and error codes, if you encounter some problem.

This chapter is organized into the following sections:

- When you install Agilent 4155B/4156B

This section explains how to solve the problems that may occur when installing the 4155B/4156B.

- If errors occur

This section lists error codes and messages that may be displayed when operating the 4155B/4156B. Also, this section describes how to read data status.

NOTE**To Get Help Information**

To start help function, press the Help front-panel key. Then, you can select one of the following primary softkeys.

- **OVERVIEW**

Briefly explains each help softkey.

- **PAGE MAP**

Shows a map of all screens, highlights the present screen name, and gives a brief description of the highlighted screen name. You can use the arrow keys to highlight another screen name, then can display the screen by selecting the **SELECT** secondary softkey.

- **FIELD INFO**

Describes field where the pointer is located on the screen, how to setup the field, and the setting restrictions. This softkey is not displayed for **GRAPHICS**, **LIST**, **KNOB SWEEP**, or **STRESS FORCE** screen.

- **DATA STAT**

Shows how to read data status, which is displayed at the bottom of **GRAPHICS**, **LIST**, **KNOB SWEEP**, or **STRESS FORCE** screen. This softkey is displayed only for these screens.

- **INPUT AID**

Displays variable names, mathematics functions, and read-out functions, and describes the highlighted name or function. This softkey is not displayed for **GRAPHICS**, **LIST**, **KNOB SWEEP**, or **STRESS FORCE** screen.

You can enter desired variable or function into the selected setup field of a screen by selecting **ENTER** secondary softkey, then pressing Enter front-panel key.

If You Have A Problem
When You Install the 4155B/4156B

When You Install the 4155B/4156B

This section covers the following basic problems that you may encounter when you install the 4155B/4156B, and the solutions.

- “If the 4155B/4156B cannot be Powered on”
- “If Measurement Units of the 41501A/B are not Displayed on the CHANNELS: CHANNEL DEFINITION Screen”
- “If External Keyboard does not Work”
- “If Display screen does not Appear after Applying Power”
- “If the 16442A Test Fixture is not Stable”
- “If Network Function does not Work”

If You Have A Problem
When You Install the 4155B/4156B

If the 4155B/4156B cannot be Powered on

- Check that the power cable is firmly connected to the 4155B/4156B and to power outlet.
- Check that the front-panel LINE switch is on.
- Check that the voltage selector switch is set properly.

The voltage selector switch is located in the lower-right corner of the rear panel. The following table shows the line voltage selector setting.

Line Voltage	Position
90 to 132 Vac	left
198 to 264 Vac	right

- Check that the fuse is good.

The fuse holder is located in the lower-right corner of the rear panel.

1. Turn the 4155B/4156B off, then disconnect the power cable from the power outlet.
2. Unscrew the fuse holder on the rear panel.
3. Inspect that the correct fuse is installed, and wire inside the fuse is *not* broken by using a tester.

Line	Fuse type	Agilent part number
100/120 Vac	UL/CSA T 8A, 250 Vac	2110-0383
220/240 Vac	UL/CSA T 4A, 250 Vac	2110-0014

4. Replace the fuse, if necessary. Then, screw in the fuse holder.
5. Turn the 4155B/4156B on.

If You Have A Problem
When You Install the 4155B/4156B

If Measurement Units of the 41501A/B are not Displayed on the CHANNELS: CHANNEL DEFINITION Screen

- Check that the power cable is firmly connected to the 41501A/B and to power outlet.
- Check that the LINE switch of the 41501A/B is on.
- Check that the voltage selector switch is set properly.

The voltage selector switch is located in the lower-right corner of the rear panel.
The following table shows the line voltage selector setting.

Line Voltage	Position
90 to 132 Vac	left
198 to 264 Vac	right

- Check that the fuse is good.

The fuse holder is located in the lower-right corner of the rear panel.

1. Turn the 4155B/4156B and the 41501A/B off.
2. Unscrew the fuse holder on the rear panel.
3. Inspect that the correct fuse is installed, and wire inside the fuse is *not* broken by using a tester.

Line	Fuse type	Agilent part number
100/120 Vac	UL/CSA T 8A, 250 Vac	2110-0383
220/240 Vac	UL/CSA T 4A, 250 Vac	2110-0014

4. Replace the fuse, if necessary. Then, screw in the fuse holder.
 5. Turn on the 41501A/B first, then turn on the 4155B/4156B.
- Check that the interface board of the 41501A/B is firmly connected to "To Expander Box Interface" of the 4155B/4156B rear panel.

If You Have A Problem
When You Install the 4155B/4156B

If External Keyboard does not Work

- Connect keyboard *first*, then turn on the 4155B/56B.
- Turn off the 4155B/4156B, then check that the connector of keyboard is firmly connected into keyboard connector of the 4155B/4156B front panel.
- Execute the External Key Controller diagnostics test on the SYSTEM: SELF-CALIBRATION/DIAGNOSTICS screen. If error occurs, write down the displayed error codes and contact the nearest Agilent Technologies Sales and Service office.

If Display screen does not Appear after Applying Power

- If the 41501A/B is installed, *first* turn on the 41501A/B, *then* turn on the 4155B/4156B.
- If the self-test fails, see “If Errors Occur when You Perform Self-calibration or Diagnostics” on page 10-12.

If the 16442A Test Fixture is not Stable

- Install stabilizers on the 16442A. For this procedure, see Chapter 2.
- If you use the 16442A test fixture with the 16440A selector or 16441A R-Box, attach the 16442A to the 16440A or 16441A by using plates and screws. For this procedure, see Chapter 2.

If Network Function does not Work

This section covers the problems on the 4155B/4156B network function, and the solutions.

- “If the 4155B/4156B cannot mount the network file system”
- “If CHANGE DIRECTORY Function does not work”
- “If GET Function does not work”
- “If SAVE Function does not work”
- “If PURGE Function does not work”
- “If RENAME Function does not work”
- “If the 4155B/4156B cannot print on a remote printer”

If You Have A Problem
When You Install the 4155B/4156B

If the 4155B/4156B cannot mount the network file system

Execute the LAN interface test. The procedure is shown in “To Connect to a LAN” in Chapter 2.

If the 4155B/4156B fails the test, contact to the nearest Agilent Technologies service office.

If the 4155B/4156B passes the test, do following:

1. Check the settings of the NETWORK SETUP table on the SYSTEM: MISCELLANEOUS screen, and set the table properly.

If the setting is ok, but the 4155B/4156B cannot mount the network file system, do following:

2. Send ping from NFS server to the 4155B/4156B.

- If the 4155B/4156B returns the responses:

- a. Check the settings of the NETWORK DRIVE SETUP table on the SYSTEM: MISCELLANEOUS screen, and set the table properly.

If the setting is ok, but the 4155B/4156B cannot mount the network file system, do following:

- b. Check the setting of the NFS server, and set it properly.

Directory specified by the NETWORK DRIVE SETUP table must be exported for the 4155B/4156B.

- If no response is returned: LAN or LAN cable may be defective. Contact to the network system administrator to solve the problem.

If CHANGE DIRECTORY Function does not work

Check the permission of the directory. The execution permission must be set. Change the permission.

If GET Function does not work

Check the permission of the file. The read permission must be set. Change the permission.

If You Have A Problem
When You Install the 4155B/4156B

If SAVE Function does not work

Check the following:

- Check the permission of the directory to save the file. The write permission must be set. Change the permission.
- If the file name has already existed on the directory, the write permission must be set for the file. Change the permission.
- If the directory has been exported with the read only permission, the 4155B/4156B cannot write a file on the directory. Retry to export the directory with read/write/execute permission.

If PURGE Function does not work

Check the following:

- Check the permission of the file to be deleted. The write permission must be set. Change the permission.
- If the directory has been exported with the read only permission, the 4155B/4156B cannot delete a file on the directory. Retry to export the directory with read/write/execute permission.

If RENAME Function does not work

Check the following:

- Check the permission of the source file. The read permission must be set. Change the permission.
- Check the permission of the directory for the target file. The write permission must be set. Change the permission.
- If the target file name has already existed on the directory, the write permission must be set for the file. Change the permission.
- If the directory has been exported with the read only permission, the 4155B/4156B cannot rename/copy a file on the directory. Retry to export the directory with read/write/execute permission.

If You Have A Problem
When You Install the 4155B/4156B

If the 4155B/4156B cannot print on a remote printer

If the 4155B/4156B cannot print on a remote printer, or the following error message is displayed on the screen, do following:

ERROR 18: Device I/O error. Unable to print out.

If you can use the 4155B/4156B as a NFS client, ignore step 1 and 2, and go to step 3.

1. Execute the LAN interface test. The procedure is shown in "To Connect to a LAN" in Chapter 2.

If the 4155B/4156B fails the test, contact to the nearest Agilent Technologies service office.

If the 4155B/4156B passes the test, do following:

2. Check the settings of the NETWORK SETUP table on the SYSTEM: MISCELLANEOUS screen, and set the table properly.

If the setting is ok, but the 4155B/4156B cannot use the remote printer, do following:

3. Send ping from the print server to the 4155B/4156B.
 - If the 4155B/4156B returns the responses:
 - a. Check the settings of the NETWORK PRINTER SETUP table on the SYSTEM: MISCELLANEOUS screen, and set the table properly.

If the setting is ok, but the 4155B/4156B cannot use the remote printer, do following:
 - b. Confirm the setting of the print server, and set it properly. lpd/lpr must be effective.
 - If no response is returned: LAN or LAN cable may be defective. Contact to the network system administrator to solve the problem.

If the desired output is not printed out, or an unwanted control character is printed at the beginning of the hard copy, check the following entry fields of the NETWORK PRINTER SETUP table, and set the fields properly.

- TEXT OUT entry field
- GRAPH OUT entry field

If Errors Occur

If the 4155B/4156B is not operated correctly, or if diagnostics or calibration fails, error codes and error messages are displayed.

If measurement or forcing stress are not performed correctly, measurement data status is displayed at bottom of GRAPHICS, LIST, KNOB SWEEP, or STRESS FORCE screen.

This section describes the following:

- “If Errors Occur when You Perform Self-calibration or Diagnostics”
- “If Errors Occur when You Operate the 4155B/4156B”
- “If a Measurement Data Status is Displayed”

If You Have A Problem

If Errors Occur

If Errors Occur when You Perform Self-calibration or Diagnostics

The following are the error codes that are displayed at the bottom of the SYSTEM: SELF-CALIBRATION/DIAGNOSTICS screen if errors occur when you perform self-calibration or diagnostics.

If errors occur, write down the displayed error codes and contact the nearest Agilent Technologies Sales and Service office. Up to seven error codes can be displayed at the bottom of the SYSTEM: SELF-CALIBRATION/DIAGNOSTICS screen. To display the error codes, move pointer to a desired test item.

Error codes for measurement unit

The following are the error codes for measurement units. Error codes are 5-digit numbers.

1xxyy

- xx: measurement unit
 - 00: VSU1,2 and VMU1,2
 - 01 to 06: SMU1 to SMU6
 - 07: PGU1,2
 - 08: GNDU
 - 09: AD converter
- yy: error number

1xx05	AD converter failed ROM or RAM self-test. Measurement unit failed AD converter test as a pretest for calibration or self-test.
1xx06	Successive approximation AD converter failed. Measurement unit failed AD converter test as a pretest for calibration or self-test.
1xx07	Integrating type AD converter failed. Measurement unit failed AD converter test as a pretest for calibration or self-test.
1xx08	AD converter test reached timeout. Measurement unit failed AD converter test as a pretest for calibration or self-test.
1xx11	Overvoltage occurred for a measurement unit.
1xx12	Overcurrent occurred for a measurement unit.

If You Have A Problem
If Errors Occur

1xx15	Measurement units that are not supported are detected.
1xx19	Emergency occurred but the cause is unknown. This is displayed, for example, when unit is known but cause is unknown.
1xx90	AD converter test reached timeout during calibration or self-test for a measurement unit.
1xx91	FIFO (first-in, first-out) for AD converter overflowed because SMU controller takes long time to read measurement data.
1xx92	Calibration or diagnostics was aborted by an emergency or *RST command.
1xx94	4155B/4156B was turned on before 41501A/B.
1xx97	Communication failed between HOST controller and SMU controller. Or calibration/diagnostics was performed, but HOST controller couldn't receive the result from SMU controller.
10030	VSUs and VMUs failed default test of calibration.
10031	VSUs and VMUs failed function check.
10032	VSUs failed gain or offset calibration.
10033	VMUs failed gain or offset calibration.
10034	VMUs failed differential mode 2 V range gain or offset calibration.
10035	VSUs failed gain and offset calibration, VMUs failed gain and offset calibration, or VMU failed differential mode 2 V range gain and offset calibration.
10036	VMUs failed differential mode 0.2 V range gain or offset measurement.
10037	VMUs failed differential mode 0.2 V range gain and offset calibration.
10038	VMUs and VSUs failed CMR (Common Mode Rejection) amp adjustment.
10040	VSU1 and VMU1 failed ± 20 V measurement self-test in 20 V range.
10041	VSU2 and VMU2 failed ± 20 V measurement self-test in 20 V range.
10042	VSU1 and VMU2 failed ± 20 V measurement self-test in 20 V range.
10043	VMU2 and VMU1 failed ± 20 V measurement self-test in 20 V range.
10044	VSU1 and VMU1 failed ± 2 V measurement self-test in 2 V range.
10045	VSU2 and VMU2 failed ± 2 V measurement self-test in 2 V range.

If You Have A Problem

If Errors Occur

- 10046** VSU1 and VMU2 failed ± 2 V measurement self-test in 2 V range.
- 10047** VSU2 and VMU1 failed ± 2 V measurement self-test in 2 V range.
- 10048** VMUs and VSUs failed differential 2 V range self-test. This test measures ± 2 V by VMUs in differential mode. (VSU1 is connected to VMU1, and VSU2 is connected to VMU2. VSU1 forces 0 V. VSU2 forces 2 V).
- 10049** VMUs and VSUs failed differential 2 V range self-test. This test measures 0 V by VMUs in differential mode. (VSU1 is connected to VMU1, and VSU2 is connected to VMU2. VSU1 forces 0 V.)
- 10050** VMUs and VSUs failed differential 0.2 V range self-test. This test measures 0 V by VMUs in differential mode. (VSU1 is connected to VMU1, and VSU2 is connected to VMU2. VSU1 forces 0 V.)
- 10051** VMUs and VSUs failed differential 2 V range self-test. This test measures 0 V by VMUs in differential mode. (VSU2 is connected to VMU1 and 2, and forces 0 V.)
- 10052** VMUs and VSUs failed differential 0.2 V range self-test. This test measures 0 V by VMUs in differential mode. (VSU2 is connected to VMU1 and 2, and forces 0 V.)
- 10x20** SMU failed function check.
- 10x21** SMU failed CMR (Common Mode Rejection) amp calibration.
- 10x22** SMU failed oscillation detector test.
- 10x23** SMU failed V set and V measure calibration.
- 10x24** SMU failed I set and I measure calibration.
- 10x25** SMU failed I bias test.
- 10x26** SMU failed V switch test.
- 10760** PGU1 failed pulse gain calibration.
- 10761** PGU2 failed pulse gain calibration.
- 10762** PGU1 failed pulse offset calibration.
- 10763** PGU2 failed pulse offset calibration.
- 10764** PGU1 failed voltage calibration of base value.
- 10765** PGU2 failed voltage calibration of base value.
- 10766** PGU1 failed leading time calibration.

**If You Have A Problem
If Errors Occur**

- 10767** PGU2 failed leading time calibration.
- 10768** PGU1 failed trailing time calibration.
- 10769** PGU2 failed trailing time calibration.
- 10770** PGU1 failed slope offset calibration.
- 10771** PGU2 failed slope offset calibration.
- 10772** PGU1 failed slope sampling calibration.
- 10773** PGU2 failed slope sampling calibration.
- 10875** GNDU failed offset calibration.
- 10905** AD converter failed ROM or RAM self-test.
- 10906** Successive approximation AD converter failed calibration or self-test.
- 10907** Integrating type AD converter failed calibration or self-test.
- 10908** AD converter reached timeout. AD converter did not return completion status within certain time after sending calibration or self-test command.

If You Have A Problem
If Errors Occur

Error code for CPU and peripherals

The following are the error codes for CPU and peripherals. Error codes are 5-digit numbers.

2wwwz

- www: test item number (on SYSTEM: SELF-CALIBRATION/DIAGNOSTICS screen).
- z: test number

23010	Host DRAM failed self-test.
23021	Host ROM failed checksum test.
23022	Host SRAM failed read and write test.
23023	EEPROM failed read and write test.
23030	Real-time clock failed timer test.
23040	GPIB controller failed self-test. This test sets some settings, then checks the status.
23050	Parallel interface controller failed self-test. This test sets some settings, then checks the status.
23061	Host controller sends a command and does not receive acknowledge from SMU controller.
23062	Host controller failed receiving response from SMU controller by sending a command.
23071	SMU controller ROM failed checksum test.
23072	SMU controller on-board SRAM failed read and write test.
23073	SMU controller internal SRAM failed read and write test.
23074	SMU controller internal timer failed self-test.
23075	SMU controller timer does not operate with correct frequency.
23076	SMU controller failed power on self-test.
23077	SMU controller test gets timeout.
23080	Access to graphics system processor failed read and write test.
23091	Graphic memories (SRAM) failed read and write test.

If You Have A Problem
If Errors Occur

23092	Graphic memories (VRAM) failed read and write test.
24017	Parallel interface failed data line test.
24018	Parallel interface failed control line test.
24021	Trigger output test failed or reached timeout.
24022	Trigger input test failed.
24041	Flexible disk drive controller test failed.
24042	Flexible disk drive 5 V power line test failed.
24051	Flexible disk drive failed diskette change test.
24052	Flexible disk drive failed read and write test.
24062	12 V source on post regulator is not output.
24063	15 V source on post regulator is not output.
24064	3 V source on post regulator is not output.
24065	LAN interface test failed.
24071	A front-panel key is stuck in pressed position.
24072	Front key assembly may be disconnected.
24073	Front-panel key controller is not functioning properly.
24100	External key controller failed self-test.
24120	Selector test reached timeout.
24130	R-Box test reached timeout.

If You Have A Problem
If Errors Occur

If Errors Occur when You Operate the 4155B/4156B

The following error codes and messages can occur when operating the 4155B/4156B. The error codes and messages are displayed in a message window or in the message display area at the bottom of the screen.

- | | |
|----|---|
| 1 | Syntax error. Input should be integer number. |
| 3 | Syntax error. Input should be real number. |
| 4 | Syntax error. Unrecognized parameter. |
| 5 | Illegal setup. The parameter is out of range. |
| 6 | DATA buffer full. Too many APPEND. |
| 7 | DATA buffer full. Too many points. |
| 8 | Cannot define more than 6 User Vars. |
| 9 | Syntax error. First char should be Alphabet. |
| 10 | Syntax error. Must be alphanumeric. |
| 11 | Name must be set for user function/variable.
Name setup cannot be omitted when setting a user function or a user variable name. |
| 12 | Syntax error. Unknown variable name. |
| 13 | System error. HOSTC received invalid data.
The 4155B/4156B may be broken. Contact the nearest Agilent Technologies Sales and Service office. |
| 14 | System error. Unable to communicate with SMUC.
The 4155B/4156B may be broken. Contact the nearest Agilent Technologies Sales and Service office. |
| 15 | System error. Illegal command to SMUC.
The 4155B/4156B may be broken. Contact the nearest Agilent Technologies Sales and Service office. |
| 16 | Illegal operation. Too many LIST data. |
| 17 | Unable to display data list. Not enough memory. |

If You Have A Problem
If Errors Occur

- 18 Device I/O error. Unable to print out.
The 4155B/4156B, printer, or plotter may be broken. Contact the nearest Agilent Technologies sales and service office.
- 19 Filer error. File name is required.
- 20 Filer error. File Type is required.
- 21 System error. Realtime clock has problem.
The 4155B/4156B may be broken. Contact the nearest Agilent Technologies Sales and Service office.
- 22 Not 4155/4156 file.
- 23 File was created by old revision.
- 24 File may be corrupt.
- 25 Zero offset meas failed for <unit name>.
Offset value is too large, so Zero offset measurement is aborted.
- 26 Too big offset for 10 pA Range of <unit name>.
Offset value is too large, so offset cannot be canceled perfectly.
- 27 System busy. Measuring.
- 28 System busy. Forcing stress.
- 29 System error. EEPROM write error.
The 4155B/4156B may be broken. Contact the nearest Agilent Technologies Sales and Service office.
- 30 Fixture open. Measurement aborted.
- 31 Auto calibration was aborted.
- 32 Auto calibration failed.
- 33 No data in internal memory.
- 34 Illegal data. File may be corrupt.
- 35 System busy. Unable to save/get when MEAS/STR.
- 36 System busy. Unable to change Y-axis.
- 37 System error. SMUC lost data.
The 4155B/4156B may be broken. Contact the nearest Agilent Technologies Sales and Service office.

If You Have A Problem
If Errors Occur

- 38 Buffer overflowed. Aborted.
- 39 Syntax error. Undisplayable character.
- 40 Illegal setup. One unit assigned several CH.
- 41 Illegal disk. Revision mismatch.
- 42 Read error occurred.
- 43 File name is not LIF type.
- 44 File name is not DOS type.
- 45 File name is not LIF/DOS type.
- 46 Volume label is not LIF type.
- 47 Volume label is not DOS type.
- 48 Incorrect memory number.
- 49 Source and Target are same.
- 50 Unable to copy. Memory full.
- 51 Unable to copy. SRC and TGT mem num is same.
You cannot specify same memory number in both SOURCE and
TARGET name fields.
- 52 Illegal suffix.
- 53 System busy. Emergency handling.
- 54 System busy. Measuring.
- 55 System busy. Executing cal/diag.
- 56 System busy. Executing auto calibration.
- 57 System busy. Printing out hard copy.
- 58 Unable to copy 4145 data file to memory.
- 59 Unable to graph plot. Recover error state.
Unable to print out or plot out when error message is displayed.
- 60 Cal/diag must be performed in the idle state.
Calibration and Diagnostics cannot be performed unless the
4155B/4156B is in the idle state. For example, this error is displayed if
the SCPI calibration command is sent when the 4155B/4156B is not in
the idle state.

If You Have A Problem
If Errors Occur

- 61 ADC time out.
The AD converter has caused a time out. Perform 109: ADC test on the SYSTEM: SELF-CALIBRATION/DIAGNOSTICS screen. If this test fails, the 4155B/4156B may need service. Contact the nearest Agilent Technologies Sales and Service office.
- 62 ADC FIFO overflow.
The AD converter has caused a FIFO overflow. A data transfer error occurred between the AD converter and the SMUC. The 4155B/4156B may need service. Contact the nearest Agilent Technologies Sales and Service office.
- 63 SMUC failed to send data to HOSTC.
The SMU controller failed to send data to the host controller. Retry the measurement. If this error is still displayed, recycle the power by turning the instrument off and then on again.
- 64 TIFF format supports SCREEN DUMP only.
The TIFF format is only supported by the SCREEN DUMP function.
- 65 TIFF image can only be written to a FILE.
A TIFF image can only be written to a FILE. The 4155B/4156B cannot output TIFF format images to a printer or plotter.
- 66 HR TIFF format supports DUMP and GRAPH PLOT.
A high resolution TIFF image is only supported by the DUMP and GRAPH PLOT functions.
- 67 HR TIFF image can only be written to a FILE.
A high resolution TIFF image can only be written to a FILE.
- 100 VAR1 is not assigned.
- 101 VAR1 assigned to multiple Channels.
- 102 VAR2 assigned to multiple Channels
- 103 VAR1' assigned to multiple Channels.
- 104 VAR1 and VAR1' must be same MODE.
- 105 Cannot set multiple SMUs to pulse mode
- 106 Cannot use VAR when SAMPLING.
- 107 Cannot use SMU pulse when SAMPLING.

If You Have A Problem
If Errors Occur

- 108 Duplicate variable names exist.
- 109 The setup is not finished.
- 110 Standby chan cannot use R-BOX resistor
For standby channel, you cannot use R-Box resistor.
- 111 Common chan cannot use R-BOX resistor.
For common mode channel, you cannot use R-Box resistor.
- 112 VAR1 step number is out of range.
- 113 START and STOP have different sign.
- 115 SMU pulse Period must be \geq Width+4ms.
- 116 VAR1 output power too large for unit.
- 117 VAR1' output power too large for unit.
- 118 VAR2 output power too large for unit.
- 119 TOT SMP TM=AUTO is for LINEAR only.
AUTO can be specified for total sampling time *only when* LINEAR sampling mode is selected.
- 120 Only LINEAR when init int \leq 480 us.
When initial interval is set to 480 μ s or less, you *cannot* specify LOG or THINNED-OUT sampling mode.
- 121 For LINEAR set AUTO if init int \leq 480us
When initial interval is set to 480 μ s or less *and* when LINEAR sampling mode is set, AUTO must be set in TOTAL SAMP. TIME field.
- 122 TOT SP TM must be \geq INIT INT (NOofSMP-1)
Total sampling time must be set in the following range:
total sampling time \geq initial interval \times (number of samples -1)
- 123 STOP CONDITION NAME is not set.
- 124 PGU pulse Period must be $>$ Width.
- 125 PGU pulse Period must be \geq Delay.

If You Have A Problem
If Errors Occur

- 126 PG leading/trailing must be same range
PGU leading and trailing time must be set in the same range. For details about the ranges, see Chapter 1 in *User's Guide: Measurement and Analysis*.
- 127 PGU Leading must be $\leq 0.8 \times \text{WIDTH}$.
Leading time must satisfy the following equation.
 $\text{leading time} \leq \text{pulse width} \times 0.8$
- 128 PGU Trailing must be $\leq 0.8 \times (\text{Peri-Wid})$.
Trailing time must satisfy the following equation.
 $\text{trailing time} \leq (\text{pulse period} - \text{pulse width}) \times 0.8$
- 129 SMU I range must be \leq Compliance range.
- 130 SYNC channel is not assigned.
At least one SYNC channel must be specified.
- 131 Assigned more than 4 SYNC channels.
- 132 Set INIT INT $\geq 2\text{ms}$ for multi-CH MEAS.
When you perform multi-channel measurements, initial interval must be 2 ms or more.
- 133 Use FIXED range when INIT INT $< 2\text{ms}$.
When you use auto ranging or limited auto ranging measurement, you must set initial interval to 2 ms or more.
- 134 Cannot disable STBY-ON ch in stress.
On STRESS: CHANNEL DEFINITION screen, you cannot disable (delete entries in row) channels that are set to STBY ON on the CHANNELS: CHANNEL DEFINITION screen.
- 135 Undefined symbol in user function.
- 136 Syntax error in user function.
- 137 Too few arguments in user function.
- 138 Too many arguments in user function.
- 139 User function area is full.
- 140 Recursive call in user function.
- 141 User function is undefined.

If You Have A Problem
If Errors Occur

- 142 Stack overflow in user function.
- 143 COMMON channel FCTN must be CONST.
- 144 COMMON channel FCTN must be NSYNC.
- 145 System busy. Unable to change page when MEAS.
- 146 System busy. Unable to change page when STRS.
- 147 Ineffective page in this setup.
- 148 X axis is not assigned.
- 149 Y1 axis is not assigned.
- 150 ENABLE DELAY must be $\leq 32767 \times \text{INIT INT}$
For sampling measurements, when stop condition is set to ENABLE,
enable delay must be initial interval $\times 32767$ or less.
- 151 No unit is set to STANDBY ON.
- 152 System busy. MEASURING (or 4145 USER MODE).
- 153 MIN, MAX have different sign in LOG.
- 154 Can do such operation only for USER VAR.
- 155 Illegal setup. The name was already used.
- 156 User variable is used in user function.
If a user variable is used in user functions, the user variable cannot be
deleted.
- 157 AUTO Analysis is undefined.
- 158 TOT SAMP TIME must be $\leq \text{INIT INT} \times 32767$.
*Total sampling time must be initial interval $\times 32767$ or less and
 1×10^{11} or less.*
- 159 Measure channel is not assigned.
- 160 Unable to find approximate data.
- 161 Illegal graph scale setup.
- 163 The Sweep/Pulse Polarity is not same.
- 164 SYNC can not be set for standby CH.

If You Have A Problem
If Errors Occur

- 165 Set value is too small for range.
For LOG sweep measurement, start and stop value must be equal or more than setup resolution. For sweep measurement, step value of VAR1 and VAR2 must be equal or more than setup resolution.
- 166 PGU Peak/Base difference must be $\leq 40V$
- 170 Use Sweep/Bias instead of SMU Pulse.
- 171 Knob Sweep sets VAR1' to CONST.
If you set VAR1' for knob sweep measurement, the VAR1' channel forces a constant value equal to START value. VAR1' cannot be a sweep source for Knob Sweep measurement.
- 172 Cannot do SAMPLING when Knob Sweep.
- 173 |STEP| must be \leq |STOP-START|.
- 174 Cannot set CONT AT ANY if PCOMP is ON.
When you set power compliance, you cannot select CONT AT ANY secondary softkey.
- 175 CONST setup must be \leq unit output range.
- 176 Pulse BASE must be \leq unit output range.
- 177 PGU pulse WIDTH must be \geq setup res.
Pulse width of PGUs must be greater than or equal to unit setup resolution.
- 178 TRIG OUT DELAY is too long.
Trigger out delay must be 32.7 ms or pulse width you specified, whichever is shorter.
- 179 Cannot ENABLE stop if INIT INT < 2 ms.
When initial interval is set to less than 2 ms, you cannot set stop condition.
- 180 Illegal setup. Target module is not installed.
- 181 Illegal setup. Invalid command.
- 182 Cannot define more than 6 User functions.
- 183 Cannot define more than 8 data vars in lists.
- 184 Cannot define more than 2 display data vars.

If You Have A Problem

If Errors Occur

- 185 ASCII format does not allow block transfer.
- 186 Block size mismatched with data format.
- 187 Y2 axis is not assigned.
- 188 List name is not assigned.
- 189 The specified name is not list name.
- 190 Illegal file type is requested.
- 191 System busy. Printing out hard copy.
- 192 Unable to set. Another controller is on bus.
- 193 Unable to specify this name here.
- 194 PGU Pulse DELAY must be \geq setup res.
PGU pulse delay time must be \geq setup resolution.
- 195 Cal/Diag failed. Cannot use unit.
- 196 Compliance too low to force pulse.
- 197 Compliance too high to force pulse.
- 198 Two VPULSE PGUs must be same STBY.
- 199 Two VPULSE PGUs must be same FCTN.
- 200 Improper parameter for file operation.
An option for the file operation command has been set up incorrectly.
- 201 System error. Filer memory overflow.
- 202 Filer error. Integer overflow.
- 203 Bad volume specifier.
Volume label for mass storage is incorrect. Initialization may have been performed on an incompatible system, or the disk may be defective.
- 204 Filer error. File type is wrong.
- 205 Filer error. EOF found.
- 206 Filer error. EOR found.
- 207 File error. Illegal DISK parameter.
Illegal disk parameter was detected. The mass storage device is set up incorrectly.

If You Have A Problem
If Errors Occur

- 208** System error. Controller not found.
Unable to access the file system. The file system controller cannot be found. The 4155B/4156B may need service. Contact the nearest Agilent Technologies Sales and Service office.
- 210** File error. Unable to execute. File open.
Unable to perform the requested file operation. The file is already open. Close the file and retry the operation.
- 211** Unable to operate the device. File is open.
Unable to perform the requested file operation on the specified device because the device has a file open.
- 212** File error. DISK or DISK drive may be broken.
DISK or DISK drive hardware may be in need of service.
- 213** Filer error. DISK record is not found.
- 214** File error. DISK record address error.
Unable to find record because the mass storage device has a problem.
- 215** Filer error. DISK record data error.
- 216** File error. DISK system error.
The hardware or the device are causing a problem.
- 217** File error. Bad volume label.
The mass storage has an incorrect volume label. Verify the volume number is set correctly.
- 218** System error. No interface found.
The network interface was not found because of a wrong select code setup. Verify the select code is set correctly.
- 219** File error. Device timeout.
Time-out occurred on the device.
- 220** Filer error. Undefined I/O path.
- 221** Filer error. Permission denied.
- 222** File error. Too many files open.
Unable to open multiple files at the same time. Close the file that is currently open before opening a second file.

If You Have A Problem
If Errors Occur

- 223 Unable to PURGE the file or directory.
 Unable to purge the file or the directory, for example, permission denied.
- 224 Filer error. The directory is not empty.
- 225 Filer error. No DISK in the drive.
- 226 Filer error. Initialization failed.
- 227 Filer error. Invalid DISK volume label.
- 228 File error. DISK volume label is undefined.
 Volume label is undefined or was not found. Verify the volume number is set correctly.
- 229 Filer error. DISK is not initialized.
- 230 Filer error. Checkread error.
- 231 Filer error. Bad HFS DISK.
- 232 Filer error. DISK is full.
- 233 Filer error. Directory is full.
- 234 Filer error. File name is undefined.
- 235 Filer error. File name is wrong.
- 236 Filer error. The file name is already used.
- 237 Filer error. Bad device type.
- 238 Filer error. Unable to use wildcard.
- 239 Filer error. Operations failed.
- 241 Filer error. The target type is wrong.
- 242 Filer error. The file is protected.
- 243 Filer error. DISK is protected.
- 244 System error. Unable to verify.
- 245 Filer error. Unable to copy between LIF/DOS.
- 246 Filer error. Reason Unknown.
- 265 HOLD TM must be ≥ 0 when INIT INT ≥ 2 ms.
- 280 VAR1' output value is out of range.

If You Have A Problem
If Errors Occur

- 282 Set INIT INT > 640 us for THINNED-OUT.
When you perform thinned-out sampling measurements, the initial interval must be more than 640 μ s.
- 284 Sampling range must be \leq 11decades.
- 286 Cannot execute cal/diag after power fail.
Turn on the 4155B/4156B again to perform calibration or diagnostics.
- 288 MEAS not finished. Incomplete data deleted.
If you press Stop front-panel key before the specified measurement finishes, incomplete measurement data is deleted.
- 289 STBY ON ch MODE(MEAS/STR) must be same
- 290 Cannot use unit after power fail.
- 292 VAR1' parameters must be \geq output res
Start, stop, and step value of VAR1' channel must be unit output resolution or more.
- 293 Cal/Diag aborted (failed on some units).
Calibration or diagnostics was aborted by receiving *RST command. So, some units maybe failed.
- 300 Over voltage is detected.
- 301 Over Current is detected.
- 302 Power failure at Main Frame.
Turn on the 4155B/4156B again. You can use filer functions after selecting OK secondary softkey (except when this error occurs during power-on test).
- 303 Power failure at Expander Box.
Turn on the 4155B/4156B again. You can use filer functions after selecting OK secondary softkey (except when this error occurs during power-on test).
- 305 Cannot shutdown Main Frame.
- 306 Emergency. Reason unknown.
An emergency occurred on an empty slot. Or an emergency occurred on an existing slot, but the reason is unspecified.

If You Have A Problem

If Errors Occur

- 307** Cannot shutdown Power Supply.
Turn on the 4155B/4156B again. You can use filer functions after selecting OK secondary softkey (except when this error occurs during power-on test).
- 308** Unknown emergency (SMUC time out).
Perform 305: HOSTC <--> SMUC I/F test on the SYSTEM: SELF-CALIBRATION/DIAGNOSTICS screen. If this test fails, the 4155B/4156B may need service. Contact the nearest Agilent Technologies Sales and Service office.
- 309** The SMU AND PULSE GENERATOR EXPANDER is not turned on.
Turn on the expander, then cycle mainframe power.
- 310** Unsupported unit detected in Slot ##. Turn off the power and remove the unit.
The displayed unit must be changed. Contact the nearest Agilent Technologies Sales and Service office.
- 320** Not enough memory. Cannot display >=200 files.
The 4155B/4156B cannot display more than 199 files on the FILE CATALOG because of an internal memory limitation. If you create more than 199 files, move the additional files to another directory.
- 321** Too many links.
The file has too many links. Remove extra links or use symbolic links.
- 322** File system down or network disconnected.
Unable to access the network directory. The file system was down or the network was disconnected.
- 323** The network address is already used.
A process has already been bound to the address. The current process must finish before the new process can use the address.
- 324** Change dir failed. File is not a directory.
Change directory failed because you specified a file, not a directory.
- 325** Unable to open file. Deadlock occurred.
Unable to open the file. Deadlock occurred in the resource where you tried to open the file.

If You Have A Problem
If Errors Occur

- 326** Device not present. Unsupported file type.
Device or driver was not found to open the file. Unable to open file because the file type is not supported.
- 327** Interrupted system call.
The lpr driver received a signal from the system, that interrupted the data transfer from the lpr driver.
- 328** lpd time out occurred. Try again ?
A time out occurred when trying to connect to the lpd server because the lpd server did not respond.
- 329** lpd print server cannot be recognized.
Unable to recognize the lpd print server. Verify the address setup or setup syntax is correct.
- 330** lpd server connection failed or was denied.
The lpd server connection failed, or was denied, because the lpd server was already connected or the server was blocked.
- 331** lpr data transfer failed.
Data transfer from the lpr server failed because lpr data communication was disconnected. Verify the network is working properly and check to see if the server is up.
- 332** Unable to print out. Not enough device space.
Unable to print out because the device connection failed. There is not enough available space in the buffer for the communication.
- 334** lpr failed data transfer. Data size mismatch.
Unable to print out because the lpr server failed data transfer. The size of the data was not the expected size.
- 335** lpr Network interface is down. Try again ?
The network interface cannot be found because the network interface for the lpr server is down.
- 336** Unable to print out. Reason unknown.
Network connection failed. The reason for the failure is unknown.

If You Have A Problem
If Errors Occur

- 337** Cannot set 0.0.0.0 for 4155/4156 IP address.
When a valid host name for the 4155B/4156B network setup is specified, the IP address of the 4155B/4156B cannot be set to 0.0.0.0.
- 338** Cannot set 0(zero) for 4155/4156 User ID.
When a valid host name for the 4155B/4156B network setup is specified, the User Id of the 4155B/4156B cannot be set to 0 (zero).
- 339** No response from NFS. Try again ?
There is no response from the Network File System (NFS) when trying to mount a network disk. Verify the network is operating properly and the file export executed properly.
- 340** Host name must be <= 15 alphanumeric character.
The 4155B/4156B host name must be 15 or less alphanumeric characters.
- 344** System busy. Cannot execute US/US42 command.
Unable to move to FLEX command control mode, because the US or US42 command cannot be executed while system is busy; making measurement, operating file functions, executing calibration or diagnostics, printing, emergency, and so on.
- 345** Change display page. DISP OFF(0) is not allowed.
Unable to enter the :DISP OFF (or 0) command when the 4155B/4156B screen displays System screen group or KNOB SWEEP screen.
- 346** Enter DISP ON(1) to execute this command.
Unable to enter the : PAGE : KSW command group, : PAGE : SCON : KSW command, or : DIAG : TEST *test_no* (*test_no*: 201 to 413) command when the 4155B/4156B screen is set to the update *disable* state by the : DISP OFF (or 0) command.
- 350** Unable to transfer data. Name buffer full.
Cannot maintain the buffer required for transferring data.
- 351** File operation was interrupted by system call.
The lpr driver received a signal from the system, which interrupted an open, read, or write operation.

If You Have A Problem
If Errors Occur

- 352** Network is down after receiving a reset.
The network is down after receiving a reset. Try again after network recovers.
- 353** Network is down. No response from server.
Network is down. There is no response from the server.
- 354** Operation canceled.
Operation canceled by user. For example, an abort command was sent.
- 355** Cannot create file/dir. Change permission.
Write permission is not set for the directory where you are trying to create a file or subdirectory.
- 357** Unable to go to the dir. Permission denied.
Cannot move to the specified directory. To access the directory, change the permissions.
- 358** Select UPDATE/ADD to update/add printer setup.
To update or add your new or modified network printer setup, the UPDATE or ADD secondary softkey must be selected after finishing the initial setup.
- 363** Duplicate file names exist.
The same file name cannot be used for multiple files.
- 364** No such file or directory.
Cannot find the specified file or directory.
- 365** Unable to read or write to directory.
A file read or write operation cannot be performed in the specified directory.
- 366** Invalid argument. Check command syntax.
Specified argument did not work when executing the command. Verify the command syntax and argument are correct.
- 367** Seek operation failed.
Seek for file operation failed, or append write failed to open the specified file.

If You Have A Problem
If Errors Occur

- 368 NFS Software caused connection abort.
Network file system (NFS) was disconnected. Verify the NFS server is operating correctly.
- 369 Connection reset by peer. Remote disconnected.
Remote connection was terminated. Verify the remote setup and the executed operation are correct. Verify the local and remote systems are operating properly.
- 370 Unable to transfer data. Communication down.
Data cannot be transferred because the communication was shutdown.
- 371 NFS Connection refused.
Connection to NFS was refused. Verify the refused device was properly exported.
- 372 Connection failed. Socket was not sent.
NFS Connection failed because the socket was not sent.
- 373 Too many levels of symbolic links.
The file is linked to itself, or the linked file is linked back to the file.
- 375 Cross-device link.
Unable to hard link different physical file systems. Hard link must be done to same file system.
- 377 Unable to use this protocol.
Unable to use this protocol on the network.
- 378 This protocol is not supported.
This protocol is not supported on the network.
- 381 This type of protocol is not supported.
This type of protocol is not supported on the network.
- 383 NFS too many references, can't splice.
- 386 System busy. Saving/getting text files.
The 4155B/4156B cannot be interrupted by other operations. For example, files cannot be saved or retrieved while making measurements.

If You Have A Problem
If Errors Occur

- 387 Unable to access file. The file is locked.
 Unable to write to this file. The file is locked by another
 process.
- 388 No such device or address.
 The 4155B/4156B cannot find the specified network device or
 address. Verify the correct device file exists, the select
 code/major number/minor number are correct, and that the
 device is correctly connected (high speed or low speed port).
- 389 System busy. File operation is in progress.
 File operation is in progress. During a file operation, the
 4155B/4156B cannot perform other operations, such as making
 measurements, changing setup fields, printing and so forth.
- 391 Network printer connection time out.
 A time out occurred when connecting the network printer to the
 print server or NFS server.
- 392 Network File System server is down.
 Server for the Network File System is down. Contact your
 network system administrator.
- 393 Communication to desired server failed.
 Communication to desired server failed.
- 394 System busy. Mounting device.
 When mounting a device, the 4155B/4156B cannot be
 interrupted by another operation, such as making a
 measurement.
- 400 System bug. Undefined method.
- 401 System bug. Invalid parameter.
- 402 System bug. Inconsistency.
- 410 Unable to display. Number must be <10001.
 Unable to display the measurement results because the data size
 of the result is too large. The number of the measurement
 results must be less than 10001.
- 411 Connection failed. Set Destination
 address.
 Network connection to destination failed. Verify the destination
 address is set correctly.
- 412 Address family not supported.
 Specified address family is not supported for the currently used
 socket.

If You Have A Problem
If Errors Occur

If a Measurement Data Status is Displayed

If measurement or stress force cannot be performed correctly, the measurement data status is displayed at the bottom of the GRAPHICS, LIST, KNOB SWEEP, or STRESS FORCE screen. The status indicates hardware and calculation errors.

The status format depends on the displayed screen as follows:

GRAPH/LIST: GRAPHICS and KNOB SWEEP screen

Status is displayed in following format:

STATUS: *AB AB AB (A A A A A A A C)*

- *AB AB AB* is for X, Y1, and Y2 axis respectively. No Y2 for KNOB SWEEP.
- *A A A A A A A C* is for SMU1 to SMU6, VMU1, VMU2, and PGU1/2 respectively.

Where, *A*, *B*, and *C* mean as follows:

- | | |
|-----------------|---|
| <i>A</i> | hardware status error. If multiple errors occur, numbers are added and displayed as a hexadecimal number. <ul style="list-style-type: none">• 1 : AD converter overflow.• 2 : Oscillation• 4 : Other channel reached compliance limit.• 8 : This channel reached compliance limit. |
| <i>B</i> | data error. If multiple errors occur, numbers are added and displayed as a hexadecimal number. <ul style="list-style-type: none">• 1 : stack register overflow• 2 : calculation error• 4 : only one data for delta measurement. At least 2 data needed. |
| <i>C</i> | PGU status <ul style="list-style-type: none">• 1 : PGU average output current exceeds 100 mA. |

For non-measurement channels, "_" is displayed.

If You Have A Problem
If Errors Occur

GRAPH/LIST: LIST screen

Status on GRAPH/LIST: LIST screen is displayed in following format:

STATUS: *AB AB AB AB AB AB AB AB (A A A A A A A C)*

- *AB AB AB AB AB AB AB AB* is for the up to 8 LIST variables that can be set up.
- *A A A A A A A C* is for SMU1 to SMU6, VMU1, VMU2, and PGU1/2 respectively.

Where, *A*, *B*, and *C* mean as follows:

A hardware status error. If multiple errors occur, numbers are added and displayed as a hexadecimal number.

- 1 : AD converter overflow.
- 2 : Oscillation
- 4 : Other channel reached compliance limit.
- 8 : This channel reached compliance limit.

B data error. If multiple errors occur, numbers are added and displayed as a hexadecimal number.

- 1 : stack register overflow
- 2 : calculation error
- 4 : only one data for delta measurement. At least 2 data needed.

C PGU status

- 1 : PGU average output current exceeds 100 mA.

For non-measurement channels, "*_*" is displayed.

If You Have A Problem

If Errors Occur

STRESS: STRESS FORCE screen

Status on STRESS: STRESS FORCE screen is displayed in following format:

STATUS: *A* *C*

Where, *A* and *C* mean as follows:

A hardware status error. If multiple errors occur, numbers are added and displayed as a hexadecimal number.

- 2 : Oscillation.
- 4 : Some channel has reached compliance limit.

C PGU status

- 1 : PGU average current exceeds 100 mA.